VOLUME 10 #1 SEPTEMBER 1994 PRICE $6

FOR THE DESIGN, CONSTRUCTION AND ENJOYMENT OF UNUSUAL SOUND SOURCES

EXPERIMENTAL MUSICAL INSTRUMENTS

HEPHAESTUS AND AEOLUS

Some long-awaited subjects appear in this issue of **Experimental Musical Instruments.** These are topics we have long intended to cover, and for which readers have often asked. The first is fire music, and the instruments known as pyrophones. Our treatment includes an opening with technical and historical background, followed by reports from several fire instrument makers. The second topic is wind music, specifically aeolian harps. Here, too, we have an introductory overview, followed by reports from makers (with more to come in EMI's next issue as well). In a related vein, this issue also contains the first installment in a series on nature sound in music, in an article by the nature sound composer/performers *McLean Mix*.

What else do we have here? Lots of lithophonic sound. Lithophones are sounding stones, such as the classical Chinese *Qing* described in Mitchell Clark's article. Two other articles in this issue likewise contain discussions and photographs of sonorous stones, so if that's an interest of yours, keep an eye out. Ellen Schultze, in her excerpted letters, gives us more anecdotal history on the rare and beautiful Deagan chimes first documented in EMI Vol. 9 #2. Steve Ball continues his exposition of electromagnetic pick-ups with a thorough step-by-step on making them. Hans van Koolwijk presents a magnificent bamboo organ. Colin Hinz describes things too offbeat to summarize here — I leave it to you to read his article.

And so forth and so on, and so forth and so on. Welcome to this, the first issue of EMI's 10th year.

IN THIS ISSUE

Above: Various composite and altered records for use on Colin Hinz's Turntable One. See the article starting on page 36.

I'VE WRITTEN Q.R. GHAZALA a few times, discussing experimental music. I am very interested in circuit bending, I've even tried it a few times. In one of my recent letters I mentioned an idea I had that he encouraged me to extend to the readers of EMI.

I have been paying attention to the very strange sounds that are "heard" as I drift in and out of sleep. Of course, the sounds I am referring to are not actually heard by the ear, they are produced by the brain as, perhaps, an aural dream. These sounds are incredibly surreal, many sounding electronic in origin ... of course the brain itself is nothing, if not an electrochemical computer. While considering this, I thought how amazing it would be if we could harness these particular electronic signals direct from the brain and interpret them into sound which could be amplified and heard by the awakened ear. Aside from the unimaginable scientific potential, the brain itself, in dreams, or conscious, could become the ultimate in experimental musical instruments. The thought of a female RCA plug behind the ear is exciting. Further, perhaps the ear could become the ultimate in ambient microphones. Further still, I imagine a concert scenario wherein audience members plug in and experience the sound of another human's brain in real time, audience participation would be as easy as a thought (the ultimate intercourse?)

It may be that the technology this idea would require to become reality is available now, or very close; consider the cochlear implant, a device which enables the deaf to "hear" by stimulating nerves at the brain stem with electronic impulses.

The largest obstacle to bringing this idea to reality is that the possibility of finding a someone willing to perform experimental surgery for a reason so frivolous as to create a sound instrument (not to mention finding the funds for the experiments). Perhaps, though, it might come to be as a tag-along technology ... discovered while attempting to create a new means of communications, or something.

Another thing that I thought may interest the readers: I have been experimenting with the compact disk as instrument. My initial activities dealt with using the forward scan/reverse scan buttons to "play" the disk. More recently I have been "creatively destroying" disks, and altering them – by perhaps sanding them, or drilling into them, or applying certain substances to their surfaces – so that the laser light has difficulty reading the data, or so that the "thinking" part of the machine does not know where to send the laser next. When a disk has been properly destroyed (it takes some practice), usually a good part of it is undamaged; one must find the affected portion. When it is found and played, the effect is most similar to a skipping record, though with several key differences. For one thing, the laser does not necessarily stay in a single "groove" (for lack of a better word), it will "jump" back and forth, sometimes backwards and forwards, sometimes covering a span of 5 or more seconds in a single jump. One revolution of a compact disk takes less than a second to complete, and in each revolution, the laser either jumps to another groove or stays put, reading data all the while, so that over a short time one might hear a variety of noises and textures, or a drone composed of a small fragment of whatever noise information happens to be on the disk, repeating over and over again. Repeating such a small fragment of a song, which normally goes by quickly enough that one may not notice if it were missing, can be like looking at that song under a microscope. The only other way of hearing such detail could only be achieved if one could slow a song down to a ridiculously slow speed, without altering the pitch.

Destroyed CDs tend to be unpredictable and difficult to control, though to some degree one can direct the laser using the scan buttons. Also, having a destroyed CD in the player confuses it to a noticeable degree, for example, when you press the eject button, you might be in for a wait before it finally gets coughed up. I have had no noticeable damage to my player, but if anyone out there is going to try this process, I urge you to use a cheap player. CD players were not designed to play destroyed CDs; who knows what kind of damage they might incur through prolonged use. I would hate for someone to ruin expensive equipment to experience what really only boils down to a cheap thrill.

For those who might want to hear some material utilizing this process, a track I've recorded, called "A Study in Compact Disk Abuse," will be appearing on the upcoming compilation *Death, Full of Flowers* on Epitapes (PO Box 458, Sunderland, MA 01375).

C. Reider
PO Box 1204, Lyons, CO 80540-1204

JUST A QUICK NOTE with my subscription renewal.

My instrument building has suffered lately – between knee-deep work at my job, a new romance, my myriad other interests – I am lately "reduced" to trying to see how many simultaneous sounds I can get out of my mouth (no other body parts or external "tools" assisting). A strange direction, but one requiring no shop work. The trick is to get a lot of mouth & throat parts flapping at the same time, generally as membranophones/aerophones, with a little bit of idiophone

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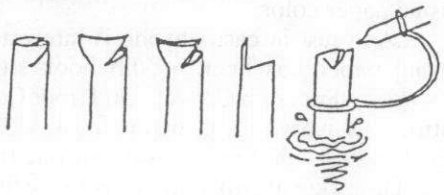
SUBMISSIONS: Experimental Musical Instruments welcomes submissions of articles relating to new or unusual musical instruments. A query letter or phone call is suggested before sending articles.

(teeth chatter). On a good day I'm up to three: vocal chords, lips (whistle), and teeth. I think four should be do-able 'cause my tongue ain't doing anything yet! I'm just not sure I can coordinate all that action. I'd like to see what others could come up with. Consider this a challenge, tongue in cheek.

Jeff Kassel

NOTES FROM HERE AND THERE

FRANÇOIS BASCHET, the French maker of architectural sound sculpture and beautiful new instruments, has sent along this simple technique for the manufacture of water whistles.



Bird Whistle: Cut tube obliquely. Raise and flatten the lip. Sharpen it. Bend it down. Lip must cover more than 50% of opening.

François writes –

I used this water whistle device three times: In a fountain in Mexico, at the University, the wind was produced by an old vacuum cleaner hidden in the cellar. I was using the exhaust end (low budget). In the Museum of Modern Art in Berlin, the compressed air was coming from glass globes in which pumps would send water. Finally in Bordeaux in a fountain still under construction. In a stone cutting school for young people on the dole.

It works.

THE EARLY MECHANICAL SCULPTURE known as Tippoo's Tiger was central to Q.R. Ghazala's article "The Video Octavox" appearing in EMI's last issue. For further information on this intriguing historical piece, look for the book *Tippoo's Tiger*, by Mildred Archer (London: Victoria & Albert Museum, 1959). Mitchell Clark, who brings the book to our attention, reports that "it has an extensive history, twenty-two plates (showing details of the tiger plus many historical illustrations relating to Tipu Sultan), and a technical bit on the organ by Henry Willis."

AN UPDATE on the Ivor Darreg Memorial Fund: As reported in EMI's last issue, following the passing of instrument builder and microtonal theorist Ivor Darreg earlier this year, several of those who had worked closely with him set up a memorial fund. The money is to be used for the production of a CD of collected musical works by Ivor Darreg, and a book of his collected writings. Sufficient funds have been collected to proceed with the CD; perchance it will have been completed and be available by the time you read this. Funds are still sought to support production of the collected writings. To order the Ivor Darreg CD at $12, or to make a contribution to the fund, write to Ivor Darreg Memorial Fund, c/o Jonathan and Elizabeth Glasier, PO Box 371443, San Diego CA 92137-1443.

Additionally, Ivor Darreg's Xenharmonic Alliance, facilitating communication between microtonalists, continues to operate under the auspices of Gary Morrison. For information, contact him at 13036 Staton Drive, Austin TX 78727-4513.

MUSICA GETUTSCHT, written by Sebastion Virdung in 1511, is an important early work on musical instruments in Europe, predating Michael Praetorius' more comprehensive *Syntagma Musicum* by a hundred years. Virdung's work has now been translated into English for the first time, by Beth Bullard. The price is US$69.95 from Cambridge University Press; included are the original German text (with some Latin), the English translation, and the full complement of original illustrative woodcuts.

"WHERE CAN I GET A THEREMIN?" Theremins, it turns out, are still manufactured by and available from Robert Moog's BIG BRIAR, Inc. Rt. 3 Box 115A, Leicester, NC 28748. The editor apologizes to the several people who asked the question, and to whom I gave rather vague answers before I became aware that the Moog instrument is still available.

A READER RECENTLY WROTE to recommend a radio show that was unusual in its thoughtful exploration of sound and music in nature and human well-being. The program was "One Tone, Two Tones, Overtones," in the "Arts Tonight" series broadcast over the Canadian Broadcasting System.

BILL AND MARY BUCHEN, who together form the group Sonic Architecture, have put together a small book of titled *Urban Sound Park Design*. Following an opening overview on sound work in public spaces, the book describes, in text and photos, four of Sonic Architecture's recent sound park projects, with the dual intent of documenting the projects and illustrating principles of sound park design. The Buchens have also recently created the 24-minute video "Sounds (like India)" exploring the sounds of the subcontinent including bike bells, stone chippers, automatic temple bells, prayer wheels and up close and personal cows. The book costs $10; the video $20, from Sonic Architecture, PO Box 20873, Tompkins Square Station, New York NY 10009.

JACQUES DUDON, whose light and water instruments were featured in EMI a few years back, is one of the forces behind 1ères RENCONTRES HARMONIQUES (First Harmonic Encounters) – a festival at the Abbey of Thoronet at Var, France set to take place August 17 - 20, 1994. Innovative instrument makers to be featured include Makoto Yabuki, Yves Rousquisto, Fred Stauffer, Serge Pesce and others. Several of the pieces will feature instruments made of natural elements (bamboo, clay, wood, stones, water). For information write Atelier d'-Explortion Harmonique, Les Camails 83.340 Le Thoronet, France, or phone (33) 94.73.87.78.

NEW EMI TAPE! Not too long after this issue reaches you, EMI's newest cassette tape will become available. **From the Pages of Experimental Musical Instruments Volume IX** is the latest in EMI's ongoing cassette series presenting the sounds of instruments that have appeared in EMI. The new one has sounds of

instruments featured in the four issues of EMI Volume IX, September 1993 through June 1994. A panoply of instruments appear, including: elemental mallet instruments from Jim Doble, Deagan Organ Chimes, as played by M.B. Cox, soundworks of ice and stone by Mineko Grimmer, extended wind instruments by Warren Burt and Brigid Burke, "aqua-lin" and other instruments from the old Marx musical instruments company, Vox Insecta by Q.R. Ghazala, flower pot-o-phone by Barry Hall, software-o-phones by Henry Lowengard, the Bellatope by Ken Lovelett, industrial strength electromagnetic pickup instruments by Steve Ball, non-linear instruments by Dan Senn, timbre & tuning explorations by Bill Sethares, a 34-tone equal temperament guitar by Larry Hanson (music composed & performed by Frick & friends), Caribbean drums by Rupert Lewis (with a mento trio), intriguing oddities by Mike Masley, and more intriguing oddities by Martien Groeneveld.

The Volume IX tape is available to subscribers for $8, and to non-subscribers for $10.50. (That includes U.S. airmail or overseas suface rate shipping. Add 20% for overseas air. In California add 7.25% tax.) Of our earlier cassettes, Volumes VI, VII and VIII are also still available, at the same prices. Checks should be made out to *Experimental Musical Instruments* at PO Box 784, Nicasio CA 94946. Order now; we'll send the tape around the start of September.

THE SAMCHILLEAN TIP TIP TIP CHEEEPEEEEE is a synthesizer interface controlled from a computer keyboard. Leon Gruenbaum, its creator, has thought a lot about the nature of the interaction between the human player, the instrument and the sound that comes out, and arrived at (in his words) "*relativity*. Striking a given key [on the Samchillean keyboard] will not sound a fixed pitch, as on a traditional keyboard. Instead, a given key-press tells the processor to make a *change* in pitch, sounding a note a specific interval away from the last note, in the scale and key signature currently selected." And there's a bit more to it than that, so ... for more information contact Leon Gruenbaum at 96 St. Marks Place, Suite #2, New York NY 10009, phone (212) 475-5363 ext. 4.

HEY, WHERE ARE THE REVIEWS?

Several features have been omitted from this issue of *Experimental Musical Instruments* because so many other things have been included. In every issue of EMI we have a space problem – how to include all the intended articles in the forty pages we normally budget for. The problem is actually a welcome one, since it reflects the fact that EMI has a lot of good material to present. In the current issue, our happy problem has proven to be even worse than usual, and so we have deferred several items: 1) You won't find Q.R. Ghazala's regular "Circuit-Bending and Living Instruments" feature. 2) Likewise, you won't find Bill Colvig's piece on making a simple metallophone, which was promised at the end of the article on Bill's instruments in the last issue. 3) As if that weren't enough, there are no book or recordings reviews in this issue either.

All of these will make their expected appearance in the coming issue. The Colvig/metallophone article will be expanded to include information from several makers who have worked with simple free-bar instruments using metal tubes (a very practical idea that has been widely used). It was with misgiving that I made the decision to hold back Reed Ghazala's article this time, since I know that I'm not alone in my appreciation of Reed's ideas and writings. The choice was based on the fact that his work has been well represented thus far, while other voices were still waiting to be heard. The usurption is temporary; Reed's writings remain one of the essential ingredients around here.

If something you had been particularly waiting for is among those deferred, apologies and thanks for your patience.

PAPER: You may have noticed that the paper on which EMI's last issue was printed was slightly different in color – a bit more tannish – than previous issues. Our printer, Barlow Printing of Petaluma, California, ordered the usual paper for the issue, but what the paper company delivered, without warning to its clients, was slightly off the usual color. We proceeded with the job on the off-color paper to avoid additional delay. Unless I get another surprise at pick-up time, the issue you're now holding will have come to you in something closer to that usual paper color.

...And just in case anyone is interested: EMI's usual paper has been a 60lb book stock in the Sycamore line from Cross Point Paper Company, in a color identified as ivory. It is made from 50% recycled material, with 10% post-consumer waste. At one time we explored the idea of using kenaf paper, made from the fibrous stalk of the fast-growing kenaf plant. Kenaf paper, according to its makers, has important long-term advantages in terms of land-use and resource management. But despite its promise from a social/economic/environmental point of view, the cost (twice our normal paper costs) pushed the use of kenaf paper into the maybe-someday category for EMI.

A BIT MORE HOUSEKEEPING

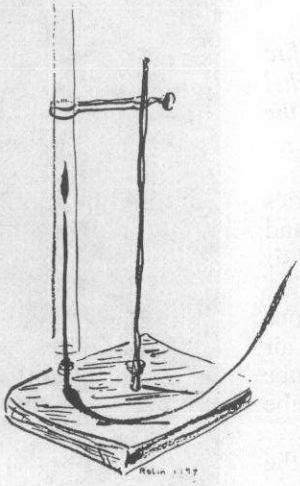
Letter writers, if you have the facilities to do it, consider sending letters-to-the-editor to EMI on computer disk. We can work with Microsoft Word files for DOS or Windows, Wordperfect files, ASCII files, DCA files and a few others, on 3 1/2" or 5 1/4" disks formatted for DOS. Whether or not you send us disk files, it is helpful to us if you send the highest-quality printed version of your writings that you conveniently can. This allows us, in lieu of reading a disk directly, to transfer the text to disk electronically by scanning. And if you have something to communicate but you're not computer-connected – well, write anyway. Use a Bic pen, use an orange crayon, use a piece of charcoal from the fireplace.

You can also fax to EMI if the occasion arises. But there is no full-time fax line at EMI's office, so call the voice phone first, at (415) 662-2182. We will then set up to receive a fax transmission.

OVERSEAS SUBSCRIBERS, please remember if you pay by check that EMI needs payment in U.S. dollars, *drawn on a bank located in the U.S.* It's not the currency exchange that kills us (that's just a couple dollars). It's the collecting from an overseas bank – a service which in most cases would actually cost more than the value of the check. Your bank can arrange for a check or money order to be drawn on a U.S. bank. Alternatively, if you have access to U.S. currency, you can just send cash through the mail. If you are concerned about whether the cash will arrive safely, send the letter by registered mail. Someday we may be able to accept payments by Visa Card, but not at this time. It is difficult for a small operation such as ours to get approval for this from the banks. Apologies for any inconvenience, and thanks for your help.

FIRE MUSIC

Introductory Notes by Bart Hopkin



Here is how to make flame sing: obtain a glass tube, one or two inches in diameter, and perhaps two or three feet long, open at both ends. Light a propane torch or similar burner, and insert the nozzle about one fourth of the way into the lower end of the tube. If conditions are right, you will hear the tone will begin not abruptly, but with a growing volume. The pitch will correspond to the resonant frequency of the tube, but higher than what one would expect as the resonant frequency for a tube of the given length due to the heating of the air. Gather together a tuned set of such tubes, develop the mechanisms to shut the flames on and off in a controlled manner, and you will have created a flame organ.

How does the flame tone come about? Michael Meadows, in a letter to *EMI* several years ago, suggested the explanation that follows. Further notes appear in the footnote below. The flame rapidly heats the air in its immediate vicinity, causing it to expand. The rapid expansion creates a pressure wave which travels to the end of the tube and partially reflects back, just as in an open-ended organ pipe. The expansion of the air and resulting rarefaction in the vicinity of the flame simultaneously creates a reduction in oxygen, causing the flame to lose intensity. This cooling, coupled with the continued rise of the heated air, draws in more oxygen-rich air from below. The air reaches the flame just as the reflected pressure wave (region of denser air) does. The flame intensifies; and the heating and resulting expansion are repeated. This is very much analogous to the process occurring in other tubular wind instruments: the frequency of a driving force, such as the puffs of air passing through a trumpet player's lips, comes into agreement with the resonant frequency of a tubular air column; the two reinforce on another, and a strong, focused oscillation at the resonant frequency is established. With the flame organ it is the oscillation in flame intensity and the resulting localized expansion and contraction of the air, rather than the air pulsing through the trumpeter's lips, that provides the initial impulse. In either case, the primary factor determining the resonant frequency is the length of the tube.*

The sounds of such an arrangement, according to people who have worked with flame tones, are highly varied. The system can be refined so as to dependably produce clear, steady tones at the frequency of the tube's fundamental. Or the mechanism can be adjusted to bring out harmonics. On the other hand, you can take a less controlling approach, and let the system come forth with a menagerie of whoops, shrieks and moans. One consistent characteristic: the attacks are not sharp; rather, each tone grows as the resonance establishes itself.

The earliest references to "burning harmonica" or "chemical harmonica" come to us from the late 1700s. A century later the physicist Georges Frédéric Eugène Kastner published *Les flammes chantantes* (Paris, 1875), a description of his fire organ, the *pyrophone*. A photograph of this instrument appeared in Kenneth Peacock's article on color organs in EMI Volume VII #2, September 1991. It appears as a moderately large console containing a small keyboard, with ten glass pipes rising from it. Later references to fire music generally take Kastner's pyrophone as a starting point.

Of modern fire organs there are not many. One has been created by engineers at the Tokyo Gas Company. It is fully functional and played regularly in public. In the following pages you will read about three more, created by contemporary artists-in-fire.

* I sent this description of flame organ mechanics to EMI's acoustics referee, Professor Donald Hall of Sacramento State University. He responded with these additional notes:

Yes, that seems a pretty good explanation of one model of what drives a flame tube. There is perhaps room for a couple of additional thoughts. The suspicion that it is a little more complicated than that might arise from suggesting that if changing air density to alter the combustion rate is the whole story, then the place where the flame should be most effective would be at the middle of a tube open at both ends. That pressure antinode is where the density fluctuations would be greatest.

On the other hand, one might think of a competing picture in which it is not the density but the motion of the air that enhances the flame by bringing fresh air into the vicinity to replace that which has been depleted of oxygen. Consequences of that model are (1) that the flame should be most effective if placed right in the mouth of the tube where the velocity oscillation is greatest, and (2) that maximum motion occurs twice per cycle (not mattering whether right or left direction). The latter means an inconsistency in the idea: the hypothesized wave gives rise to an effect that should reinforce a different wave an octave higher in pitch rather than itself. That inconsistency can perhaps be removed if there is a steady stream of air through the tube, so that left/right motion superimposed upon that (steady plus some more vs. steady diminished by same amount) makes a total speed which is faster/slower at times half a cycle apart, thus now the right frequency to be self-reinforcing. Maybe that has something to do with such tubes working in a vertical position with air rising through them as in a chimney but not when horizontal (or at any rate maybe not as well).

Insofar as such tubes actually are found to respond best to a flame about a quarter pipe length inside (one-eighth wavelength, halfway between node and antinode, a place where both density and velocity are fluctuating), it may indicate that each of the competing explanations is partially true, with a situation where they can help each other out being better than either can do by itself.

BIBLIOGRAPHY, SORT OF

Published information on flame organs is rather scarce. Most references are brief. Following are a few sources that touch on the topic. Please forgive the incompleteness in some of the references; interested readers may be able to fill in the missing information, or perhaps come up with further references.

Bragg, William: **World of Sound** (Dover, 1920; 2nd ed. 1968).

Hauch (?): Article in Kopenhagen (phys. chem. naturh. und math.), Abhandl. aus der neuen Sammlung der Wissenschaften, ubersetz von D.P. Scheel und C.F. Degen, Kopenhagen, 1798, Vol 1, 1st part, p. 55.

Kastner, Georges Frédéric Eugène: **Les flammes chantantes** (Paris, 1875).

Rayleigh, Lord: **Theory of Sound** (1877).

Sachs, Curt: **Reallexicon der Musikinstrumente** (Berlin 1913).

Hopkins, George M.: **Experimental Science**: **Elementary Practical and Experimental Physics** (Lindsay Publications Inc., Bradley, IL 1987; originally published in New Yor, 1906).

ACKNOWLDEGMENTS

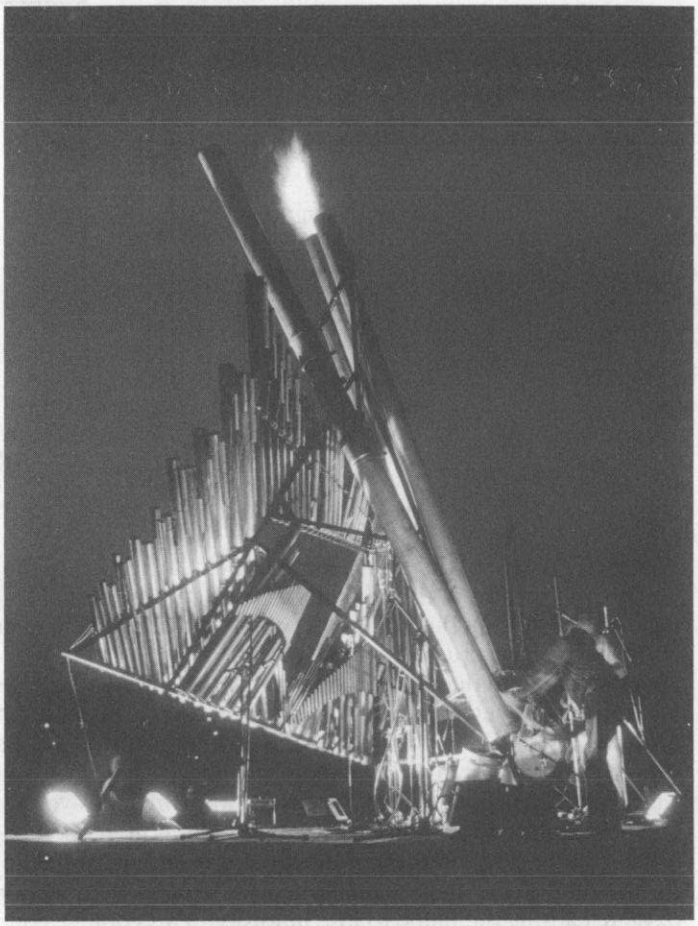
Several people at different times have provided me with information that I have drawn on here, among them: Norman Andersen, François Baschet, Donald Hall, Dennis James, Shig Kihara, Michael Meadows, Michel Moglia, Itiyé Poulsen, Leo Tadagawa, and Trimpin.

MICHEL MOGLIA'S FIRE ORGAN

Photos this page: Michel Moglia's Fire Organ. Photos by Nicholas Sersiron.

By Etiyé Dimma Poulsen

On this page, Etiyé Dimma Poulsen describes a contemporary fire instrument, L'Orgue a Feu, *created by the French sound artist Michel Moglia. On the following page, Michel provides some insight into the philosophy behind his work.*



The Fire Organ consists of a pyramid structure which carries between 250-300 tubes (in stainless steel) at different diameters and lengths. The instrument has a wide sonorous range consisting of six untempered octaves (if we refer to the classical musical scale).

The sound is produced by the flame of a burner which functions with propane gas, using the propane gas cylinders made for hot air balloons. The burner, which is held in the hand, heats the chosen tube which in return gives a sound corresponding to the length of the tube in question.

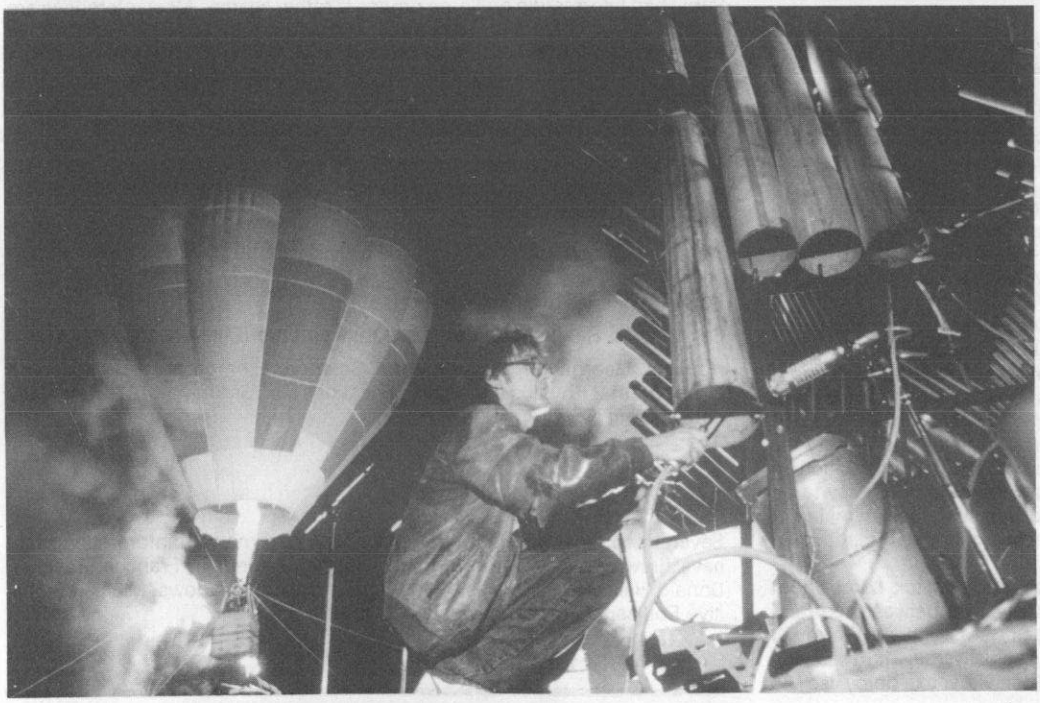
In fact the flame isn't always placed in the tube, as it is with the pyrophone. The flame heats a metallic mass which is placed in a given position in the tube. Once you remove the burner an exchange of heat is produced in the tube which finally evokes the vibration of the air stream. The vibration lasts several seconds; this enables you to play other notes simultaneously so as to give a harmony. The harmonies change continually as if living due to the varying thermal changes.

One can provoke micro-tonalities, evolutive thumpings, varying loudness, forces and pitches, screams, calls of animals, etc.... Different types of burners allow the player to make effects similar to those of respiration of mammals.

Conceptually the Fire Organ has little to do with the Pyrophone: It neither sounds nor looks like a classical instrument with a keyboard. The sound it emits is closer to nature than culture. It allows one to play with aleatoric effects caused by the flame.

The flame is partly free and can vary in length and intensity. The music of the Fire Organ includes violence and mildness, the force and the fragility of the flame, both on a visual and sonorous level. Certain flames are several meters long due to the employment of liquid gas.

The Fire Organ also has a percussive system generated by mini-gas explosions which take place in titanium tubes (using solenoid valves).



Finally the Fire Organ, accompanied by a surrounding of musicians specialized in new sonorous research, is used especially in ritual performances by night in spectacular sceneries and places, for example:

A concert which took place in Cei, Ural, in front of an audience of 10,000 people. A huge Fire Organ of more than 10 meters high was placed in an electric power station, which permitted us to divert the gas of the power station for our "thermal chants".

The aim of the Fire Organ is to try to find a new sonorous atmosphere which differs voluntarily from what we commonly call "music," because the lastly mentioned is nothing but a vibratory coded system used in a precise cultural universe.

This creation is based on the following ideas:

Energy, different potentials
Control, chance
Order and Disorder

Further information can be found at the following address: Michel Moglia, 1 route de Gron, Serilly, 89510 Etigny, France.

MICHEL MOGLIA'S THERMAL CHANTS
The infinite vibration of the flame, of time and life...

by Michel Moglia
Translated from the French by Etiyé Poulsen

As time goes by, all sonorous phenomena which are related to the innumerable aspects of combustion and transfers of energy have gradually become a kind of an obsession to me. Ranging from the roaring of the thunder storm to the whistling of the wind, passing by the heavy beatings of motors on a ship, followed by the staccato of thermal motors, going all the way to the breathings and calls of mammals, whales, fawns, of humans, right to the singing of birds at the break of dawn ... All these sounds at times formless to an inattentive ear, all this immense and mysterious sonorous universe, has become a kind of reference to me, a family which I have wanted to belong to as an active creator and participant, conscious of the forces which surround me.

That's how I decided one day to compose with my screams, my own thermal chants. A way to mix with the others in a huge thermal symphony.

This intuitive desire to be in harmony with the elements that have contributed to the beginning of life, which are life in themselves, seems remote to most western musical approaches in which one often struggles to control the tempo. They force themselves to regulate the modulation of the sound by means of sophisticated technology and skilled interpreters submitted to the cultural norms of society.

The thermal chants owe a lot to unwritten "primitive music" which takes into consideration exterior effects in their musical game. They equally owe a lot to John Cage who undoubtedly was one of the first composers to have consciously shared with his interpreters the idea of randomness in music...

Opposed to all kinds of systems founded on ideas such as domination and control, my aim consists in playing with the flame, time, my life, and chance effects: elements that seem fluid and that one ought to accept as variables undecided beforehand.

Of course one is free to organize a kind of rule to this game depending on one's own emotional wishes. Its fascinating to compose a piece of music accepting equally to compose with the latent uncertainly. One can compare it with the attitude of sailors who at times put up their sails against the wind and succeed despite (or maybe thanks to) everything in reaching their aim the aim of getting to the end of the initiatory voyage...

To accept mystery and the role it plays in our lives is essential. The ritual, the sacrifice, the risk of being condemned to the stake still roam in our minds, for the better and for the worse. Therefore, both the violence and the danger are founding elements of the thermal chants. The most dangerous and unexplored territory on earth is life; it is us...

Composing a thermal chant by using either classical, primitive or post-industrial instruments, organizing the breathing, voices, screams, releasing the roars of motors or concentrating on listening to the crystalline rustling of running water or on the vibration of a dancing flame, to "sculpt" the whole in a visual and sonorous universe, all this is undoubtedly a means by which I try to find my own roots, which stretches beyond our strong and omnipresent cultural system.

TRIMPIN

The Seattle-based German composer and builder Trimpin is currently doing some work with fire instruments. He sends these notes:

About ten years ago I was starting to experiment with sound and fire, sparks (high voltage), flames etc. I tried to synchronize the aural/visual effects. I came up with a old upright piano where only the strings with the soundboard were left – everything else was removed. On the bottom of the strings an electromagnet was attached, so every time a string was "hammered" on, a 3-4 inch light-spark would travel up the string. The whole piano was hooked up on 15000 volts. I never used it in a performance, until last year where it was a small part in the performance D.R.A.M.A.ohno. The name of the instrument is *Charged Piano*.

At the same time I was also experimenting with the pyrophone idea. For years I have been thinking to build a huge setup with computer-controlled flame valves. Now finally this year [1993] it will be built. I was invited as artist in residence this summer at the Pilchuk School of Glass where all the colorful pyrex glass in different shapes and forms will be blown. It is planned to be performed next spring (1994) in New York. Besides the *Fireorgan* there is also a human voice accompaniment, sung and improvised by Tom Buckner. The installation can be operated by keyboard or computer. Other elements are also included like synchronized water drips falling down into the flames, making sounds and changing the color, etc.

Right now [fall 1993] I have an installation "PHFFFFT-ARRRRRGH" at the Tacoma Art Museum. It will then go on to New York and Switzerland.

PFFFT-ARRRGH! was shown in Tacoma through February 1994. In keeping with Trimpin's extensive work in computer control of acoustic instruments, the installation was made up of computer-controlled wind instruments of all sorts, distributed widely through the gallery space, playing themselves in intricately controlled patterns of rapid rhythmic interaction.

PLAYING WITH PYROPHONES

By Norman Andersen

The fascination began as a child; it was difficult to resist the allure of matches. My childhood studies of what burned and what didn't may not have been scientific, but I was learning something in the process. Fortunately, I curbed my young appetite for fire after nearly burning down the large pine tree in front of my parent's house.

Fire studies continued, but in somewhat more sophisticated fashion, as I proceeded through high school and college. I went into the field of fine art, and on the side, had a very strong interest in music and sound. Ultimately, I found myself making kinetic sound-producing sculpture (Figure 1) and satisfying the integration of a number of interests. My fascination for fire patiently waited.

Opportunity arose with a potential sculpture commission offered by the Duluth Water & Gas Company in Minnesota in 1988. Among the criteria for a potential work of art was the desire to have water and gas (presumably flame) used in the sculpture. Experience had taught me the difficulties of using water in sculptural projects (too numerous to mention here), but the challenge of gas and fire was too much technical punishment to pass up (besides, I knew few artists with the information necessary to attack this problem). The project was right up my alley, and after considerable thought and site research, I began to conjure up a softly spoken sound sculpture using resonating tubes with pitched gurgling water, a sheet of falling "rain," and, for real excitement, a glass pyrophone (Figure 2). All these visual and auditory elements would be controlled by an electromechanical random sequencing system like others I have typically employed in my sculptures.

My information on the pyrophone was limited[1]. A friend had provided me with photocopies from an old book entitled *Experimental Science*[2] (Chapter VIII, "Sound") which described a method by which sound could be produced using a thin flame within an open-ended tube (Figure 3). I called upon my personal pyrotechnical history, and began experimenting. Not having a science lab and subsequent ready supply of natural gas at my disposal, I began studies with the use of a basic propane torch. I could CAREFULLY position the torch in a vise with the flame pointing straight up, then lower a variety of heat-proof tubes over the flame until something happened (hopefully not an explosion). It wasn't long before I had a sound, and it was an interesting sound at that! I tested many variables: length of tube, diameter of tube, size of flame, different torch heads, and position of flame with respect to the open bottom of the tube. All these variables led to different sound characteristics (timbre) within a pretty stable pitch relative to the length of tube.

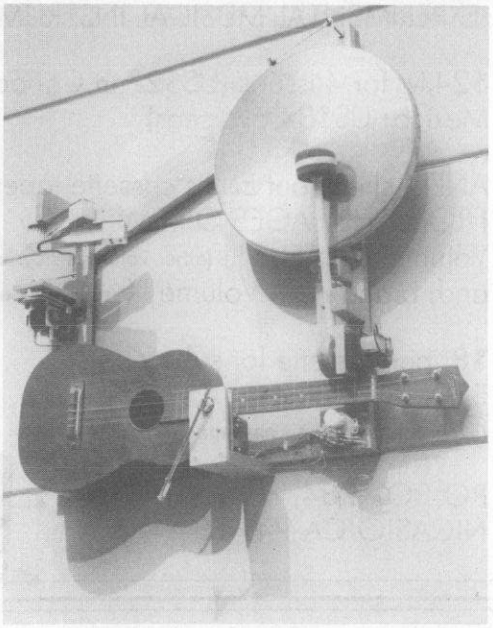
One of the earliest results from my tests was that the *thin flame* approach suggested through book research proved ineffective for me; I could get no satisfying sound response. It seems that a broader source of heat is required, such as that created by the standard tip on a propane torch. I surmised (perhaps a scientist among you can verify) that in order to set up the necessary *standing wave* needed to vibrate air and generate sound, heating the air across most of the width of the tube is required. This is contrary to the type of *convection current* that results from the narrow flame heat source.

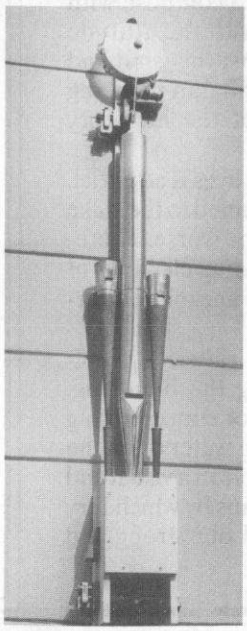
Because my limited research wasn't helping to any great extent, I decided I was pretty much on my own with this technology, winging it in my customary empirical fashion. The next hurdle for my particular application was to figure out how to get natural gas (under moderately low pressure) to imitate the heat pattern of the torch used in my experiments. By this time, I had tapped into the pilot light fittings of my home's furnace for a ready supply of natural gas (it was summer, and the heat wasn't on.).

I wanted to take advantage of the well-developed technologies already existing for gas appliances. I also thought that commercially available systems must somehow be safer and would be more to the liking of the Duluth Gas Company, than parts I might design and build from scratch myself. I knew that I had to add air to the gas in order to obtain a nice hot blue flame, so I began by investing in a couple of mixer valves like you would find inside a gas range or cook-top. These valves provide the

1. I might add that I later found the image of an early pyrophone (ca.1870) in an article, "Instruments to Perform Color Music," by Kenneth Peacock, in **Leonardo** Vol. 21 #4, p. 396-406, 1988. A revised version of the article, with the pyrophone photo included, also appeared in EMI Volume VII #2, Sept. 1991. There is not much technical information on the instrument, but it's fun to look at.

2. George M. Hopkins, **Experimental Science — Elementary Practical and Experimental Physics** (Bradley, IL: Lindsay Publications, 1987. Originally published in New York, 1907).





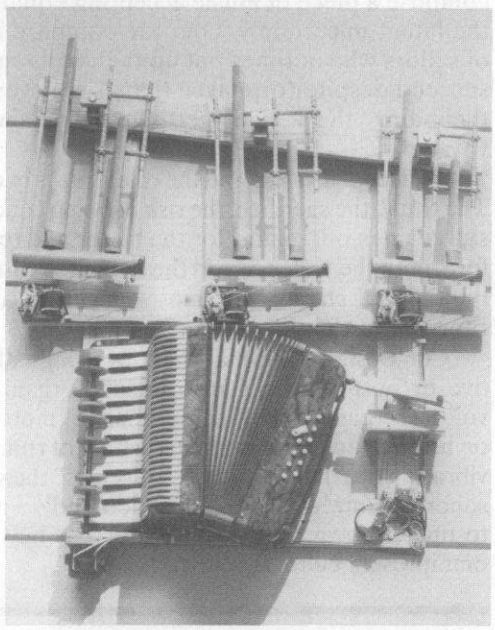


Figure 1 : Details from installation "Clamorama" 1990 by Norman Andersen. Three of the four electrically actuated acoustic modules that made up the sculpture are shown here.

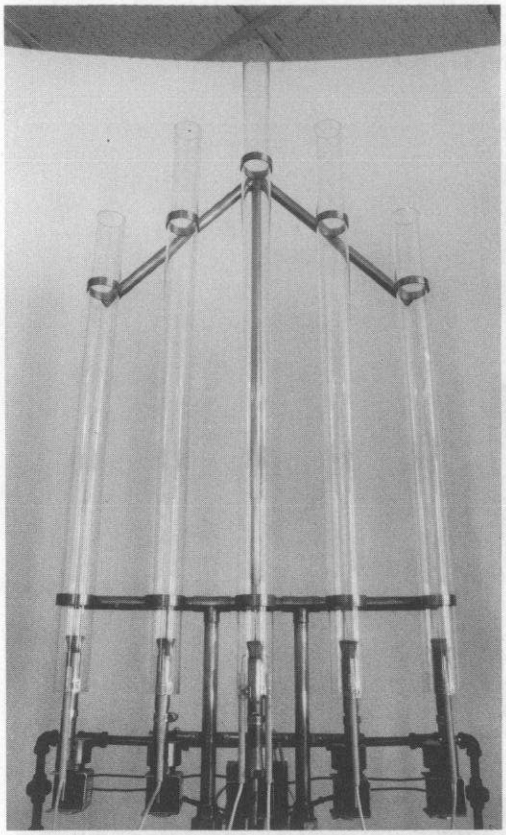
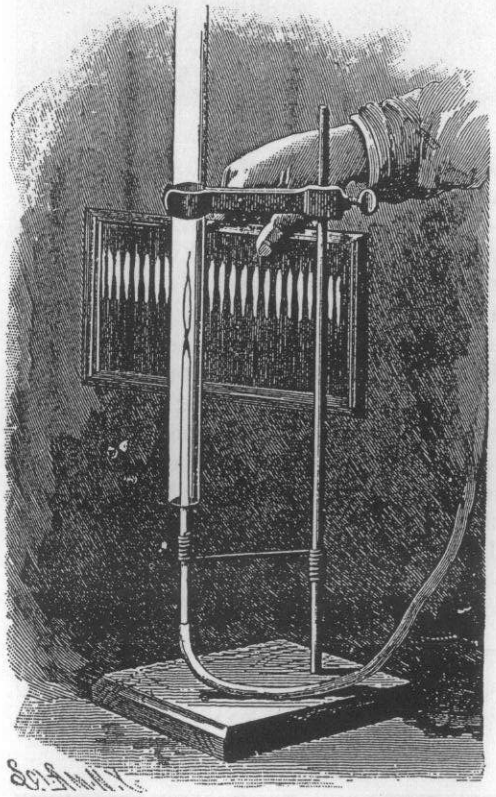


Figure 2: Detail of Norman Andersen's "Siren" sound sculpture 1990/ Gas fired pyrophone unit.

Figure 3: "Production of Sounding Flames" – an illustration from George M. Hopkins' **Experimental Science — Elementary Practical and Experimental Physics**, 1904 (republished by Lindsey Publications, Bradley IL, 1987).



essential *venturi* (a narrow orifice) which accelerates the low pressure gas between vents in order to draw in combustion air. Lots of great components can be purchased at appliance part stores, but it's probably best not to say what you're going to do with them. Parts store guys always want part numbers, so just getting something generic can be tricky. My usual approach is to ask for the cheapest one, since it is most often the simplest in configuration and most useful to the experimenter.

Once I had the mixer valve, I inserted the venturi end into a 1/2" diameter copper tube about 6" long, in which I had drilled two 3/8" holes to accept air alongside the venturi. I could control the airflow with a small metal hose clamp, and the gas flow with the commercial valve (Figure 4). I felt like I was getting down to a controllable science, but then had to concentrate on devising some kind of a *burner head.* I tried many options using different kinds of *caps* with patterns of holes in them (almost imitating a range top burner in miniature). A few of these designs began to yield some results but were subject to uneven lighting and burning.

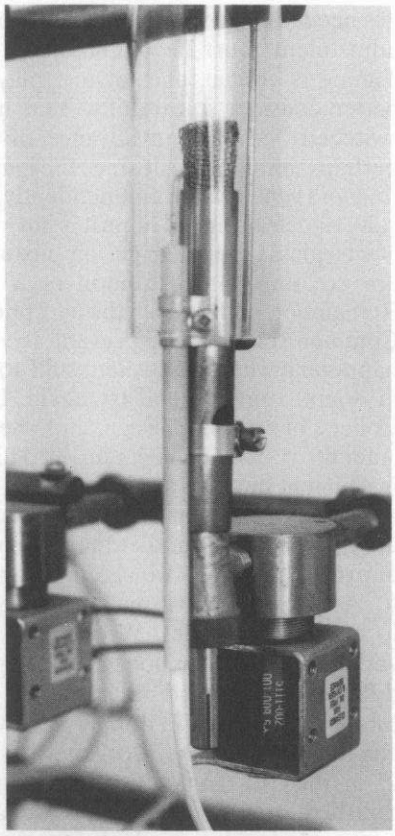


Figure 4: Detail showing configuration of burner, valve, and igniter on one of Andersen's pyrophone tubes.

The standing waves within the pyrophone tube can set up a pretty strong pulse of pressure on the flame. With many of my test burners, the sound waves would extinguish the flame, or at least enough parts of it, to prevent generation of more sound. The problem was getting frustrating and difficult. The flame needs to be able to vibrate in intensity as a response to the waves it creates. One is encouraging a kind of a feedback system because of the controlled airflow of the tube. I asked myself, How do you generate a broad plasma of flame heat, and also keep it ignited in an environment that is trying to crush it? Scanning my memory of hot, glowing, burning things, I suddenly remembered camping trips and the old Coleman lantern with its ingenious glowing mantle. This was the answer I was looking for.

I had no intention of using actual lantern mantles; in addition to being too large and delicate, I didn't want bright white light in my sculpture. I reasoned that if a delicate ash mesh could contain and maintain a flame, other kinds of mesh might also work, as long as they could withstand the heat. I found a piece of old steel window screen, cut out a small circle, formed it into a kind of *dome* shape over a rounded dowel rod, and inserted it in the burner end of my copper tube. PRESTO! I was very pleased to discover the solution to my problem. The gas flame was small, hot, and very controlled. The wire screening quickly glowed a dim orange color, and provided plenty of re-ignition potential. All parts of the *burner head* stayed lit consistently, it used very little gas, and the best part was the interesting sounds that could be made.

Unfortunately, another tricky problem still had to be solved for my pyrophone to be fully functional; how could these gas burners be reliably and safely ignited. Originally I had considered using high-voltage arcs generated by neon sign transformers, but I discovered something better.

The *ignition system* for my sculpture again made use of appliance technology. I discovered the wonderful electronic high-voltage igniters which are also found in kitchen ranges in the place of pilot lights. These igniters can be bought as replacement parts, and consist of a ceramic bound electrode with special high-temperature wire, and an electronic module operating on 120vac (standard household current). The modules are very compact, and upon applying the input voltage, they respond with repeated "firings" of high voltage (low current) sparks from the electrode to any ground (which a burner is likely to be). The sparks come at intervals of one to two per second.

Having ignition is meaningless without a gas/air mixture to light. The amount of

gas needed to keep a good sound going is very small, so careful adjustment must be maintained to ensure proper ignition. Timing is crucial, and anyone playing around with this stuff better consider it carefully. You have to get the gas supply switched "on" just in advance of the ignition sequence (or perhaps simultaneously since the igniters repeatedly fire). I used *solenoid valves* which independently feed each pyrophone mixer valve and its burner. I hope it is obvious to readers that you don't want a glass tube full of gas/air mixture to get ignited, unless you are creating a pyro-cannon or a pyro-fragmentation bomb. Remember, both ends of the pyrophone tube must remain open. Common sense should prevent accidents. Think about what is happening where and when, sniff for gas frequently, and when in doubt, ventilate and try again. I teach at the Minneapolis College of Art and Design, and one of my critical rules for my students is: "No one gets hurt!" This may be sound advice for instrument builders as well.

On my particular instrument/sculpture titled "Siren" (Figure 5), you may note that there are only three different lengths of pyrophone tube, two at 2 ft., two at 2.5 ft., and the tallest at 3 ft.. As any instrument maker understands, this choice limits us to only three pitches. Wrong .... There are so many kooky variables with pyrophone technology, that quite a number of different timbres and pitches might be achieved even from one tube (frequencies can double or halve and dominant harmonics can fluctuate just like in organ pipes). All of "Siren's" tubes are 2" in outside diameter, and are made of Pyrex with flame polished ends. Pyrex tubing is available from chemistry supply companies, and it may be best to have them cut it. Clear tubes are not necessary, of course, but it's nice to see what's going on inside, especially since the flame is usually located at least a couple inches up from the bottom. Remember that combustion gasses have to pass through the length of the tube, so don/t get any ideas about stopping them.

On my sculpture, I have adjusted the pyrophones to yield some interesting sounds:

The tallest pipe sounds something like a low-pitched distant fog horn (it is breathy and vibrant).

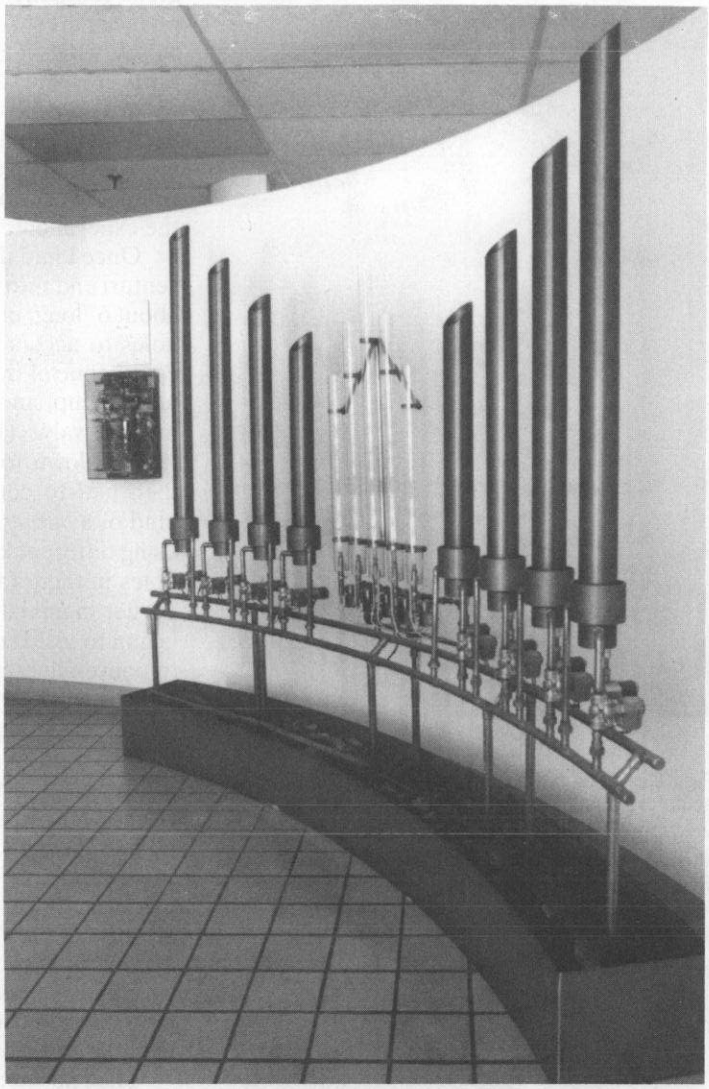
The 2.5 footers operate simultaneously as a pair, sounding something like hooting ships' whistles at a distance (also with some *white noise*).

The shortest pair also operate together, making a kind of yelping sound which might be associated with coyotes or even wolves (apparently caused by a secondary or harmonic wave which oscillates the principal pitch at a slow rate).

It may be helpful to the reader unfamiliar with Minnesota to know that Duluth (the permanent home of the sculpture) is an important harbor on Lake Superior which boasts a wild and scenic shoreline. When these strange pyrophone-induced sounds are combined in irregular and unpredictable sequences with the hydraulic aspects of the sculpture, the result is a strange mechanical concert of natural sounds. The occasional clinking of twenty-one solenoid valves which control gases and fluids is an unavoidable aspect of the technology. I like to think that the mechanical sounds help to ground us in our place, reminding the viewer of our technological clunkiness relative to nature.

While I have outlined my experimentation and results with the pyrophone, I hope it is obvious that I have only scratched the surface of possibilities for this technology. I hope that some brave reader may consider additional development, and perhaps even come up with a new playable instrument (I'm sure someone somewhere has already). It should be noted that

Figure 5: "Siren" 1990 sound sculpture by Norman Andersen. Pyrophone is surrounded by blue anodized aluminum tubes which emit changing pitches of gurgling water sounds,



pyrophone sounds are "building" sounds; it takes a few seconds for the air in the column to be heated enough to begin to speak. I think it would be quite difficult to build an instrument with staccato capabilities using pyrophone science. I would imagine a pyrophone instrument to have similar musical characteristics to a glass harmonica or bowed glass bars, only breathier.

I hope that this article has been helpful to those who might venture into the realm of pyrophones. Perhaps others may find interest in recognizing that many of us share the same creative problem solving process. I'm sure there are some readers who have already experimented with pyrophone science, and it would be fun to hear about your results. While I will make no promises, I would like to write about other sculptures, noise-making systems, and instrument projects that I am involved in. Meanwhile, as always, I look forward to learning the latest from the rest of you in EMI. Keep up the good and important work.

Norman Andersen can be reached at 3220 Park Ave. S., Minneapolis, MN 55407, U.S.A., phone (612) 823-6454.

MORE ON THE DEAGAN CHIMES

And My Father's Stone Chimes, Too

Excerpted from letters by Ellen Schultze

Following publication of an article on the Deagan Organ Chimes in EMI's December 1993 issue, Ellen Schultze wrote with a generous helping of additional information on the topic. The editor encouraged her to enlarge upon it and send photographs. Here is her story.

I was very excited to read about the organ chimes in the December 1993 issue of *Experimental Musical Instruments*. You see, I own a set of the Triple Octave Shaker Chimes, manufactured by the Deagan Co., and have done considerable research into the background. I have been putting together the history of the Chimes – both the Triple Chimes and the Deagan Organ Chimes, bit by bit. And every once in awhile, I manage to secure some strong evidence that enlarges the scope considerably.

I was visiting my grandparents in Lodi, California when I was twelve years old (1928) and they took me to their church to hear Rev. and Mrs. Alley of Oregon, in musical concert. They did their ministry through music. They had collected a number of unusual musical instruments and presented them in concert. I began playing the piano when I was seven years old, and by the time I was twelve, I was playing the pump organ for the Methodist Church services in Tuolumne. I soon took up the flute and piccolo, and from time to time added other instruments. I was fascinated by the Alleys and their music. I fell in love with their Triple Octave Shaker Chimes and I decided that when I grew up and got a job, the first thing I would buy would be a set of the chimes. No one knew what I was taking about but I didn't forget those sounds from the chimes.

I graduated from High School in 1934, and the Great Depression had hit our little lumber and mining community hard. Only my father and one other father of a member of our graduating class of twenty-three students were employed. Being the oldest of a large family, college was out of the question. I went to business college in Stockton and worked my way through, holding down 3 part-time jobs. I completed the course, took a civil service test, and received an appointment to a position in Sacramento. Three days before my moving date, the Alleys were in Stockton to give another of their concerts. I attended and sure enough, they still had the marvelous Triple Octave Shaker Chimes!

I introduced myself following the program and told Rev. Alley I had heard him when I was twelve, and had fallen in love with the chimes. I stated I was going to begin working for the State of California on Monday, and would be earning the fabulous salary of $70 a month (unheard of for a woman to earn more than $50 a month), and I could buy anything I wanted and I wanted a set of the Triple Chimes. He held my hands and, with deep compassion, told me there was no way I could own a set of the chimes. He explained they had been made in 1894, 1895, and 1896, for the traveling tent shows of Chautauqua. Only twenty-one sets had been made by the Deagan people, and in 1936 there were only fourteen sets still in existence. Chautauqua was an Educational and Religious Show that traveled around the world. It was before radio, movies, and TV, and when Chautauqua came to town and set up their tent, everyone came! It was great entertainment. They always had a leading evangelist or lecturer such as Billy Sunday, and they included outstanding music. They used Deagan instruments considerably because of their unusualness.

Ellen Schultze with the Triple Octave Shaker Chimes.

My research leads me to believe that a missionary serving in the East Indies brought an angklung to the Deagan Co. and asked if they could duplicate it. A contract was signed that tied Deagan down to making twenty-one sets, and only twenty-one sets, of the Triple Octave Shaker Chimes. Being Deagan, he figured out how to get around it. He made 300 sets with a fourth pipe for each note, identical to the third pipe, and called them Deagan Organ Chimes. He also made 40 aluminum sets and called them Deagan Aluminum Chimes. I have found very few of the aluminum sets still in existence, but have located a number of the Deagan four tubes sets.

With the advent of movies, radio, etc., Chautauqua went out of existence in 1924, with one tent group continuing into early 1926, when they also folded up.

At that time, there were fifteen of the Chime sets still in existence. They take a beating with the constant shaking of the notes. These were sold – mostly to ministers or evangelists, but two sets went to vaudeville entertainers. The set I own is one of those. After a year on tour, the owner advertised his set for sale in *Variety*. Rev. Alley, a former vaudeville entertainer, subscribed to *Variety*, saw the ad and immediately bought the set. He played the musical saw, had two sets of musical bells, musical glasses, electric doorbells, and other odd instru-

Ellen Schultze playing the Deagan Aluminum Chimes at Circus World Museum in Baraboo, Wisconsin. Background provided by Gargantua, the largest gorilla ever exhibited. To the right can be seen other instruments, including what appears to be a Deagan Aluminum Harp – a tuned set of narrow aluminum tubes sounded by friction with rosined gloves.

ments. He owned one of the first Vibraharps made by Deagan, and that, along with the chimes, added a lot of class to their musical presentation.

In 1956, my father, James F. Cooper, became the national president of the American Bell Association. We had become interested in musical bells and my Dad had purchased many sets of musical bells, and also put together sets himself. We had twenty-seven sets of musical bells in the family with four generations playing the bells. At the national convention of the A.B.A. in 1956, he had four generations of his family give an hour of entertainment with their bell ringing. The Alleys were in the audience. They didn't identify themselves to any of us, so we did not know they were there.

In 1971, Rev. Alley called from Oregon to talk to my father. He explained that their health had failed and they were giving up their musical ministry. They hadn't forgotten our outstanding family entertainment, and they wanted a Christian family who were entertainers to have first chance at their instruments. My Dad called me to say he was going to Oregon to see what they had. I almost went through the phone. "Dad, the Triple Octave Shaker Chimes – they're mine!!" I also bought the singing glasses, the doorbells, and the sleighbells on sticks.

Disneyland in Anaheim has a shaker chime set without the rack. The Barber Shop Quartet in Main Street America uses them. Half the set is at Disney World in Florida and half is in California. The manager of Disneyland came to me and said he had heard I had a set of the chimes. He said he wanted to buy them. "They aren't for sale" I said sweetly. He smiled and said, "You may name your own price!" And I again smiled back and again spoke sweetly, saying "They aren't for sale". He said, "If you can name your own price, anything's for sale!" I didn't smile this time – I looked him right in the eye and said, "You've learned something today, haven't you!" I had waited forty-eight years and when I got the very set I had heard when I was twelve, there is no way I would let it go!

The shaker chimes are an emotional instrument. When I play "Amazing Grace" and "How Great Thou Art", many people wipe their eyes. We nearly always get a standing ovation at the conclusion of our programs. We enjoy performing. This is an avocation – not our profession.

I put on an hour's program. My husband is not a musician, but he is a great backup. We have family jokes and lots of laughs, and people must enjoy the program because we get asked to return time and time again! It also gives us an opportunity of doing low key witnessing of our faith.

My parents were rockhounds. My Dad especially loved hunting in the deserts in California, Arizona, Nevada and Oregon. He was in the desert near the Death Valley monument, when he came across a narrow, small canyon. He entered and found the walls were of limestone. The floor was littered with slabs of limestone that had broken off and fallen to the floor. He accidentally kicked a slab that hit another slab and gave off a bell like chime. He picked it up but while he held it, there was no resonance. His fingers totally "drowned" any resonant sound. He used a piece of string he had with him, and tied it around the slabs he had picked up, and even tapping with just his fingernails, produced a sound. Intrigued, he brought home about twenty slabs.

When he tested the tonal quality, he found he had just four different notes. There are very few pieces you can play with just four notes, so he put the slabs to one side until he could return to the small canyon and get another load. He brought home fifty or sixty this time. Still only a few more notes evolved. He decided to try "tuning" them by breaking off a piece. This action completely killed the tone. They had to be left as God created them! He filed a small niche on the sides of the slabs, and hung them with fishline.

Each time my husband Carl and I, or my two sisters and their spouses, came home to visit, Dad would give us the tuning fork and some marimba mallets (worn out ones I had given him), and

Ellen Schultze playing the Singing Stones made by her father.

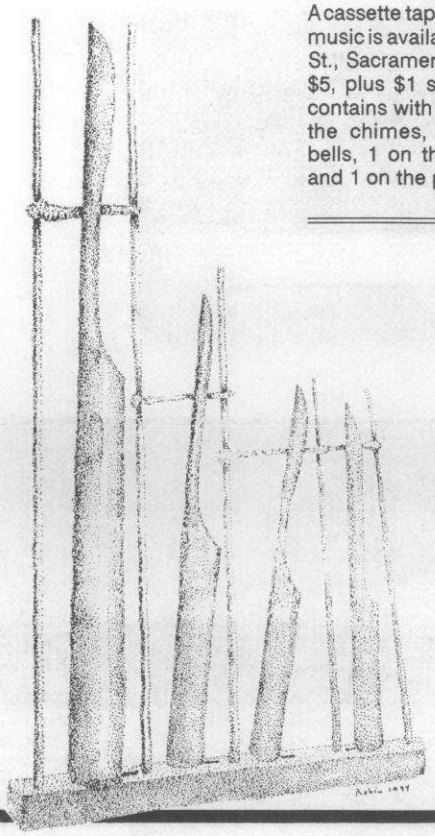
we would test the rocks. He had a row of boxes in the backyard marked A, A#, B, C, C#, D, D#, etc. After you tune about fifteen or twenty of the rocks, they begin to sound alike! It took us five years to get through all the huge pile of rocks he had accumulated by that time. We found some boxes contained as many as thirty notes, and some had one or two. We were able to put together five sets of Singing Stones – none of them in the same key because we had to work with the stones we had.

Dad built a frame of pipes, and bore holes in the top of the pipes. He tied fishline near the top of the slabs, and extended the twine up about five or six inches on each side. He placed draery hooks at the end of the twine, and these are placed into the holes on the pipe. They hang free and swing when struck with a mallet. Geologists tell us these rocks are 20 million years old, so that actually makes it our oldest instrument! My Dad was so thrilled with putting together such an original instrument, and later saw an item in the Encyclopedia that said the Chinese invented an instrument of stones over fou thousand years ago!! So much for "unique", but it is an Experimental Instrument, that's for sure.

These stones are remarkably well tuned. In the set I use, only the first note lacks full resonance but it is in perfect harmony, and I need it for several of the pieces I play on the rocks. Dad had a long piece of a wooden pipe that he cut in half. He placed nails along the edge and strung twine across using the nails to hold the twine. He placed slabs on this and had eight notes in the key of C that he kept in his "Bell Room". He used it mainly to demonstrate when school youngsters came to call and see the huge collection of bells. One of the family members has that now.

We were performing at a Church Family Night Dinner when a teenager interrupted the program. "Can I ask you a question?" he asked. "Is all the music you're going to play Old Time Music?" I was just getting ready to play on the rocks, so I responded by saying "Hang in there, Son, you're just about to hear some Hard Rock." (This story is told often when we put on a program. Lots of corn, but people seem to love it.)

A cassette tape of Ellen Schultze's music is available from 1516 42nd St., Sacramento CA 95819; price $5, plus $1 shipping charges. It contains with 9 pieces played on the chimes, 1 on four-in-hand bells, 1 on the limestone rocks, and 1 on the piccolo bells.

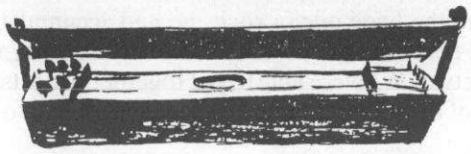


One note from a Deagan Organ Chimes set.

Drawing by Robin Goodfellow.

AEOLIAN HARPS

By Sasha Bogdanowitsch



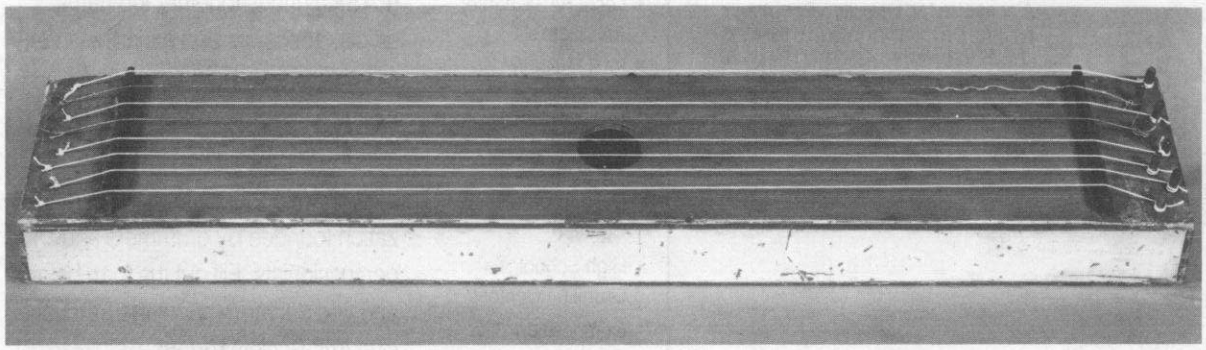
Everyone has probably heard about *aeolian harps* – chordophones played not by human hands, but by the breath of wind – but many do not know of their fantastical history, and their present popularity with a small number of adventurous instrument builders. In Part I of this collection of articles, we will investigate the historical development and construction of the aeolian harp of the West, from its ancient history in Europe and Asia and its technological boom in the 1500s, to its surge of popularity in the 1700s and its sparse but fertile existence today in the hands of independent instrument builders. We will also hear from two contemporary aeolian harp builders, Australian Ros Bandt and Canadian John Oughton, as well as a few experiments by the author. Part II, appearing in EMI's next issue, will continue the attention paid to contemporary builders, this time centering on the works of Americans Tom Pierce and Richard Lerman.

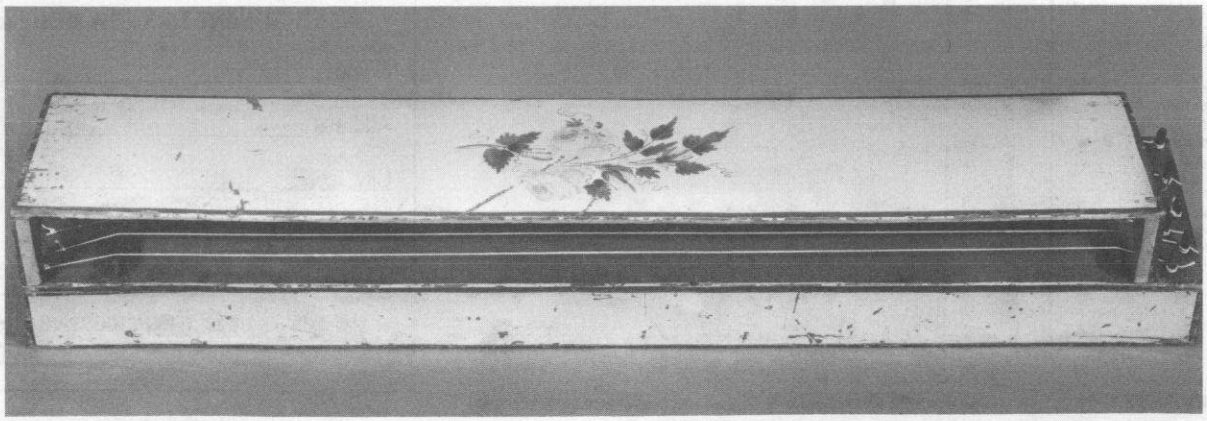
AEOLIAN DEFINITION AND ORIGINS

Deriving its name from the Greek god of wind, *Aeolus*, an aeolian harp has traditionally been known, at least in the West, as a simple, small board or box zither having usually about four to twelve strings of gut or brass, known to sing etheral tones when played upon by the wind. The zither was placed in especially windy places, like rooftops, windows, or outdoor court yards, situated or designed in such a way that the wind was directed across the strings. This caused them to be set in motion, sounding the harmonic series of the fundamental that each string was tuned to. Of course, there are many variables in the creation of the sound, such as wind pressure, soundboxs, strings and the like, but these will be touched upon later in this article.

Incidentally, the term "aeolian harp" is a misnomer. According to generally accepted definitions, a harp has strings in a plane perpendicular to the soundboard, while zithers have theirs parallel to the soundboard. There can be and are examples of actual harps played by the wind, but in most cases a more correct term would be *aeolian zither*. But since the term *aeolian harp* is so widely used, we shall use it in this article.

We will first look at the aeolian harp's historical origins in Europe and West Asia. Though possibly belonging to the realm of fable and legend, there are two occurences that appear in accordance with the discovery of the aeolian harp. They are, first, the discovery of music made by wind blowing in dried animal entrails, and the second, the marvel of God-deriven wind that blows on an already invented musical instrument. The first is cited in Homer's "Hymn to Hermes," circa 800 B.C., in which Hermes hears wind blowing on the dried sinews of a tortoise carapace while strolling on a beach. It is interesting to note that the Greek and Roman names for lyre are synonymous with tortoise carapace. Another example is found in an undated Turkish legend in which music sprouts forth from a dried monkey's entrails hanging from a branch of a tree, blown by the wind.





Above and right: Aeolian harp, maker unknown, made in the United States, 19th century. Shown with the lid removed (above) and in place (below).

Gift of Miss Sarah Norton. Courtesy, Museum of Fine Arts, Boston.

Europe is not the only seat of aeolian harp activity in the world. In Africa and South America, there are aeolian instruments constructed of natural materials, while in Java and China, bamboo bow kites (*subungan* and *feng cheng*) have existed for centuries. Unfortunately, because there is little accessible scholarly work in this area, this article has had to limit its focus to Western history and development.

Special mention should be made of Stephen Bonner's *Aeolian Harp* [Bois de Boulogue, Oxford, Cambridge, 1968-74], and Gordon Monahan's article "Singing Wires," in *Musicworks 30* (Winter 1985) for providing the majority of the historical research upon which this article is based. The Bonner book, unfortunately, is out of print and now a great rarity.

The second discovery of aeolian music attributes it to divinely influenced wind, having its origins in Hebraic legend in the Old Testament . The story had it that King David would hang his harp above his head when he went to bed at night to receive the God-sent wind that would blow against it at that sacred time.

Other examples come from such distant lands as India and England. In the 15th century , Indian poet, Magh, wrote of the six stringed *mohati vina* being sounded by the wind of the heavenly sage, Narada. From 10th century England comes a legend that St. Dunstan of Canterbury, while sewing a clerical vestment that had been requested by the bishop, had his harp played upon by God, producing the anthem *Gaudent in coelis*.

AEOLIAN DEVELOPMENT

Though these examples suggest that at least the concept of aeolian harps has been around for centuries, it was not until 1540 A.D. that we see any written documentation signifying the existence of instruments made specifically to be sounded by the wind.

The idea may have first been presented by Jean Baptista or Giambattista della Porta of Naples (1535-1615) . Porta was a natural philosopher who was the first scientist to discover the heating effects of light rays. In his major work, *Magia Naturalis* (Natural Magic), Porta examines magic as a technique to control the phenomena of nature. Among other subjects such as magnetism, the camera obscura, and demonology, the phenomenon of aeolian music is mentioned. A quote from the publication states,

> ... to make a harp to be played on by the wind do thus: when the winds are very tempestuous set your instrument just against it; the wind will run violently into them; whence if you stand near and listen you will hear a most pleasant music.

It is not till the 17th century in Rome that we see more significant activity concerning the wind harp. During this period, the Jesuit priest and scholar Athanasius Kircher (1601-1680), whose vast research and experimentation in the fields of geography, astronomy, music, mathematics, language, and medicine earned him the name "late Renaissance man," claims to have invented the instrument, calling it the "musical autophone." Though probably deriving the idea and lines about construction from Porta, Kircher, in his 1650 publication *Musurgia Universalis*, presented a theory of aeolian tones that is still referred to today. One very convincing quote mentions,

> . . . the string divides into vibrating sections, according to the irregularity of wind intensity along its length, thus producing various harmonic pitches relating to the divisons of the string.

AEOLIAN POPULARITY

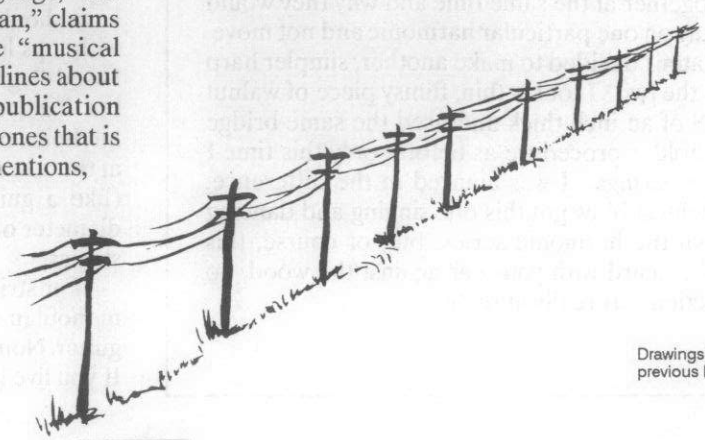
After Kircher's discoveries and developments, it was not until the middle of the 1700s that the aeolian harp really gained popularity as a novelty instrument among Europeans, especially the English. Literary articles and poetry about the aeolian harp helped fuel the fire that kept the instrument alive and popular. In the early 1700s, the well-known English poet and satrist, Alexander Pope, contributed to the popularity of the aeolian harp via his Homer translations, in works such as *The Commentary of Eusthasius.* James Thomson was one of the first English poets to mention the instrument in his 1748 poem, *Castle of Indolence*, and, in 1754, the *Gentleman's Magazine* published a report on a construction of the wind harp from an anonymous writer. Forty-seven years later author William Jones wrote his article "On the Eolian Harp" in his *Physiological Disquisitions*. In it he describes his "air prism" theory, saying that "...the air yields no particular musical tone without the assistance of some sonorous body to separate its parts and put them into vibratory motion." He also tells of his desire to sell his vertical model based upon Kircher's design at a reasonable price to the readers.

But probably the most famous are the references made to the aeolian harp by the poet/writers, Samuel Taylor Coleridge and Henry David Thoreau. In *The Eolian Harp,* Coleridge writes,

> "And that simplest Lute,/Placed length-ways in the clasping casement, hark!? How by the desultory breeze caressed,/ Like some coy maid half yielding to her lover,/ It pours such sweet upbraiding, . . . its strings /Boldlier swept, the long sequacious notes / Over delicious surges sink and rise,/Such a soft floating witchery of sound . . ."

From his Journals, Thoreau writes of telegraph wire vibrating in the wind,

> "The resounding wood! how much the ancients would have made of it! To have a harp so great a scale, girdling the very earth, and layed on by the winds of every latitude and longitude, and that harp were, as it were, the manifest blessing of heaven on a work of man's! . . . this (is a) magic medium of communication for mankind!"

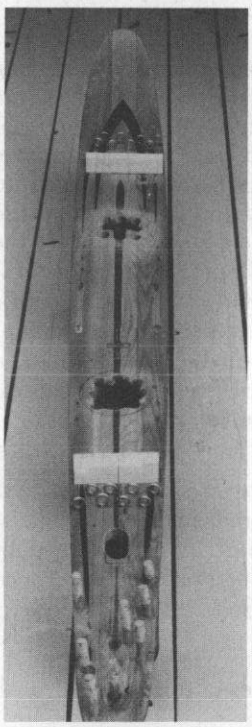


Drawings this page and previous by Robin Goodfellow

By the mid to late 1800s, the aeolian harp had become a fashionable popular amusement among aristocrats in royal houses. Strangely enough, this surge of attention was not much echoed outside of England. France was not keen on the aeolian harp, and Spain was certainly unimpressed. Germany, on the other hand, developed a deep love of it. Noticing the English had a head start, the Germans manufactured instruments and literary articles at an amazing rate, causing the instrument to be used in wide variety of outdoor places, including gardens, grottos, ruins, and parks.

From this hundred-year period to the present, there is a surprising disappearance of documentation of aeolian instruments, and it is not until relatively recently that we can see the aeolian interest being revived once again in the hands of independent instrument builders working in their own self-styled directions, as will be seen in the reports appearing along with this article.

SKI HARP



My own attempts at construction of an aeolian harp met with mixed results. Not having the best materials or tools at hand for the creation of a proper sound box, I decided to use an antique wooden ski that my mother had laying about her studio. On the ski I gouged out two holes with a drill, chisel, and file, and attached one tin can resonator and one long plastic tube resonator. I added two pyramidal wooden bridges on either end, screws, and homemade wooden tuning pins (made from dowels by my mother) to hold the eight strings of varied gauges of monofilament fishing line and piano steel wire.

The harp is pretty much inaudible in quet winds, but quite loud with one's ear to the end of one of the resonators. This works out wonderfully, but keeps the instrument at a very personal, private level.

In the strong winds, it sings out more clearly, but still not quite as loud or present as I was expecting. Also, I couldn't realize why strings would be activated singularly instead of together at the same time and why they would appear to stay on one particular harmonic and not move.

A little later I decided to make another, simpler harp to compare the two. I took a thin, flimsy piece of walnut about an 1/8 of an inch thick and used the same bridge and tuning holder procedure as before, only this time I used just two strings. I was amazed in the difference. Even the slightest blow got this one singing and dancing up and down the harmonic series, but, of course, this could only be heard with your ear against the wood, no outer projection was really audible.

—SB

THE STORY OF AEOLIAN HARPS

by John Oughton

The music produced by the aeolian harp proves to be much easier to identify than the exact way in which the wind moves the strings. If a string is tuned to middle C and a current of air is blown across it, it will produce a harmonic series in "aliquot parts" varying with the force of the wind, including the third – E – and fifth – G, the octave of C, the third and fifth above it, and so on up the scale. The fundamental note, the low C, will never be heard.

One note will sound much louder than the others. This occurs, according to *Grove's Dictionary of Music,* "when the velocity of the air-stream is that needed to produce an Aeolian tone with a frequency equal to that of one of the natural sectional vibrations of the string." Thus the most varied sounds will be produced by an aeolian harp with strings of different thicknesses; if they are all tuned to the same fundamental note, they will sound in harmonies with each other, and different wind speeds will produce the note of "maximum resonance" from each string.

After years of controversy about how the air moved the strings, the British scientist, Lord Rayleigh, using a simple homemade apparatus, proved that the string set into motion by an air current actually vibrates at *right angles* to the direction of the airflow. Eddies of air behind the string (relative to the airflow direction) produce the sound, and larger eddies (from thicker strings) produce lower tones.

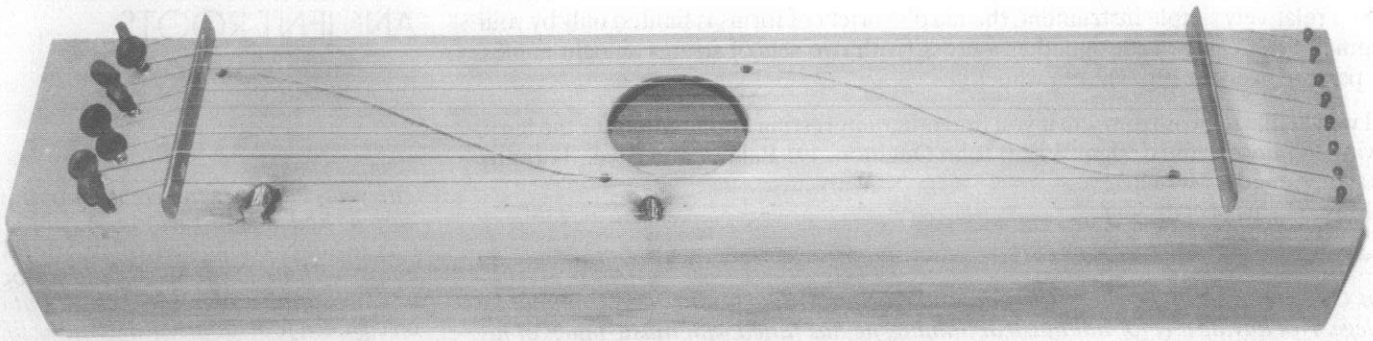
The most common design in the history of aeolian harp construction was a simple pine box about three feet long, five inches wide and three inches deep, with hardwood ends. About a dozen gut strings, tuned slackly but in unison (to the same note) passed over bridges at either end and were held by tuning pegs at one end and hitchpins at the other. A "wing" or top board concentrated the air flow over the strings. The design shown at the end of this article is a modern variation of this style

An aeolian harp is much easier for a part-time carpenter to build than other stringed instruments, since only right angles are involved in the basic design, and the exact distance of the strings from the soundboard is unimportant. The design shown here with mitered corners can be most easily built using a table saw and a jigsaw. However, the harp can also be cut and assembled with no more than a couple of good handsaws – a full-sized one and a keyhole saw – if you use simple butt joints (or you overlap the edges of the box rather than making a joint), a drill, wood glue, nails or screws, a few clamps, and a hammer or screwdriver.

For the best looks and durability, hardwood bridges and ends are recommended (pine tends to split when holes are drilled in it close together). Pine or cedar makes a good top and sides; the more the soundboard is planed down, the more responsive the harp should be (although there is a risk of splitting or cracking with tops less than 1/4" thick). In my latest model, shown below, I used elegant ebony tuning pegs from a violin supply/repair shop, but handcarved ones would work just as well. Plastic guitar hitchpins or simple wooden tapered pegs can secure the strings at the other end of the harp. The soundholes can be made round (like a guitar's), in the violin "f-hole" shape, or both. The diameter of the round hole is determined by the span across the strings.

For strings, I used a combination of various gauges of nylon monofilament fishing line and the top three strings of a classical guitar. Non-rusting nylon strings stand up better than metal ones. If you live in a damp climate, it's a good idea to finish your harp

Aeolian harp by John Oughton



with verathane or a similar plastic coating.

Your harp should play pretty consistently as long as a moderate wind is blowing. It will be loudest when placed where a draft or wind current occurs, such as in an open window, at the corner of a building, in a tree or on a hill (or, for that matter, on a sailboat or car roof!) Don't fix the harp in place; you'll want to be able to turn it to the wind, and bring it inside during bad weather. If the harp produces only faint sounds, concentrate the wind more by adding the wing to the top of the harp (as shown in the design), creating a wind tunnel. Using one wing support centered at either end of the wing allows you to experiment with tilting it. That top board can serve double duty as a bird feeder if you put a ridge around it to keep the seeds in place.

You'll find the harp a great source of meditation/relaxation music (a tape of its song makes a good gift for similarly-minded friends), a good conversation piece, and an interesting natural drone box for your own improvisations on other instruments like guitar and flute. Try tuning the harp to a note in your instrument's range, and then play as the harp backs you up.

AEOLIAN HARP ASSEMBLY INSTRUCTIONS

1. See the drawing on the following page. Cut pieces from 1/4" or 5/16" wood (except where otherwise noted). If possible use pine or cedar for the top, sides and bottom, hardwood for the ends and bridges.

The Top: To accomodate the violin-style tuning pegs I used, I drilled 5/16" holes. The holes were slanted back about 15 degrees from vertical to keep the pegs from pulling out or slipping after tuning. The key holes should be in two rows, staggered by about 1/4" to allow room for the heads to turn. The edge of the two holes nearest the sides should be about 1/4" in. To accomodate the plastic hitch pins at the other end, drill 3/16" holes. These need not be angled back or staggered.

The easiest way to cut the central sound hole is to trace a 4" diameter circle centered in the top, then drill a hole at the edge of the circle large enough to start the blade of your jigsaw or keyhole saw. Cut the hole out and file or sand it smooth. I used mitered corners for my harp; depending on your tools and preference, you could make a right angled butt or overlap joint instead.

2. Fasten the side pieces to the bottom. Use finishing nail or small wood screws, wood glue, and clamp the sides and ends to the bottom until the glue is set.

3. Fasten the top in the same way.

4. Fine sand and varathane all surfaces (wing and supports too).

5. Cut nylon strings about 40" in length, using as many different thicknesses of monofilament as possible. The three top strings (G,B,E) of a classical guitar may be used too. Tie a knot at one end of the string, and insert it into the hitchpin hole. Now push the pin in to hold the string. The other end of the string should be taken through the small hole in the tuning peg and knotted around the peg, leaving some slack.

6. Insert the bridges, narrow end up, between the strings and top. They should be positioned about two inches from the tuning pegs and hitchpins. You can notch the bridges lightly to keep each string in place on them. Tune the strings to the same low note (try the low E on a guitar for a start).

7. Now fasten the wing supports on. Center each one on an end of the harp, attach with wood screws. Now attach the wing with a large woodscrew that passes through a washer, then the support and into the wing. By loosening and tightening the screws, you can vary and fix the tilt of the wing. It may be necessary to remove the wing occasionally to replace the strings, pegs, etc.

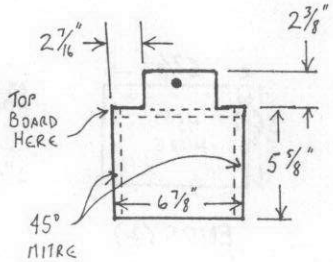
8. Find some wind and let it play. If you have trouble getting it to play, try: lowering bridge height, top board clearance over strings; replacing nylon strings with metal strings; changing pitch of strings; putting a spoiler on the wind side of the top board so that it "funnels" more wind over strings; changing spacing and order of strings.

DESIGN VARIATIONS

1. Some models use metal strings (which are louder than nylon), and fasten them with a simple metal tuning key, turned by a wrench, much as zithers are tuned.

2. Build a large rudder mounted on a pivot at 90 degrees to the harp, and then mount the harp on the pivot so that it turns into the wind.

3. A more elegant way to mount the wing than the add-on supports shown in the plans is to make the support an integral part of the end pieces. Cut the end pieces as shown here.



4. If you have the ambition and wood for a bigger harp, you could simply multiply the dimensions given here by 1.5 or 2; the harp should work just as well, although classical guitar strings will then be too short. You'll have to use fishing line and nylon thread.

5. Build a cheap microphone inside the harp's box, wired to a jack on the side. Plug a line from the jack into an amplifier and

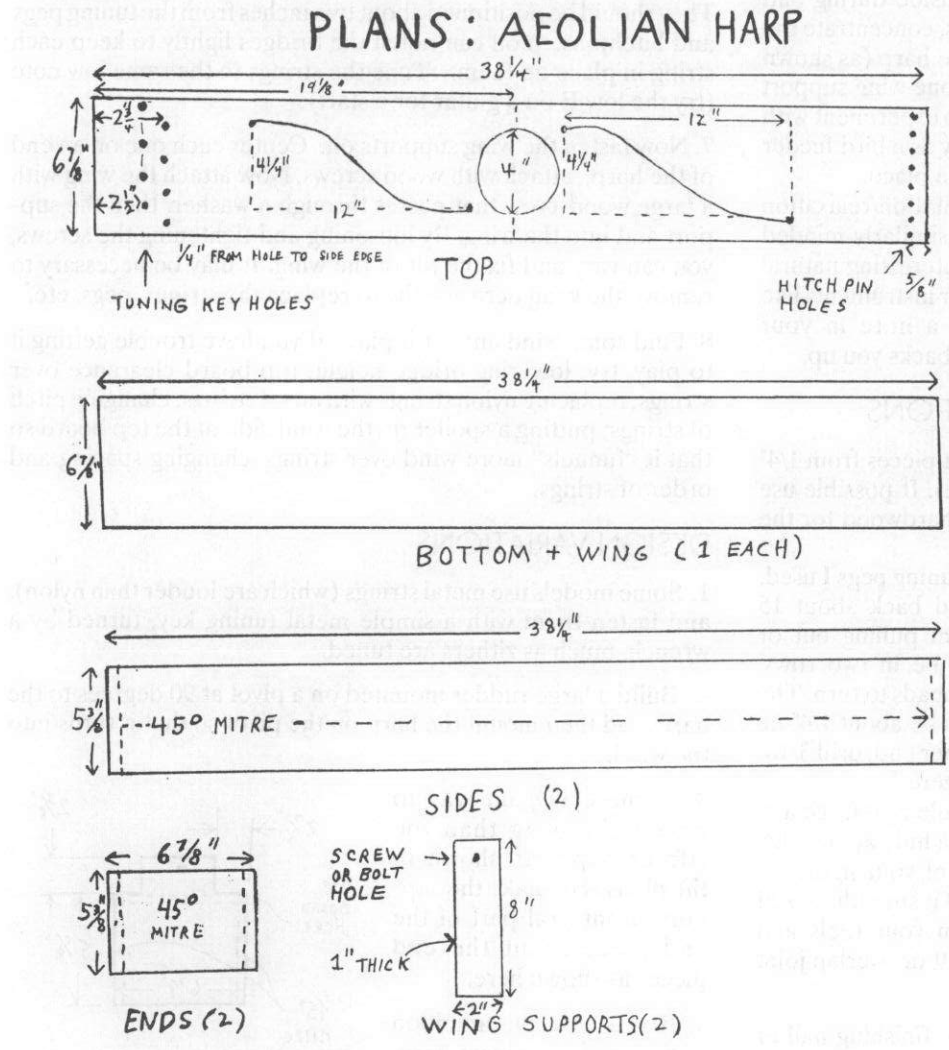
you have an electric wind harp!

6. As a relatively simple instrument, the harp's variety of forms is limited only by your imagination. It can be redesigned as a cross (with two sets of strings ar right angles, one passing over the other), or a wheel.

I would like to hear from you if you find other interesting applications for the harp, or ways to improve the design. Write: John Oughton, 491 Palmerston Blvd., Toronto, Ontario, Canada, M6G 2P2.

May Aeolus be with you...

John Oughton lives in Toronto, Canada and teaches writing at Sheridan Community College. Not having any formal musical training, he has flirted with music much of his life, taking electronic music courses as well as English literature at York University. He fools around on guitar and percussion and has accompanied experimental dance, performance art, and theatre pieces. In the 1980s, he built two aeolian harps, researched the instrument, and sold a pamphlet on them by mail-order. He wants to connect his brain to a MIDI interface and perform white middle-aged virtual reality rap music.



THE AEOLIAN HARPS: ANCIENT ROOTS

By Ros Bandt

The year 1988 saw the creation of a wind harp at Redcliffs in Victoria, Australia. It was actually comprised of six subsidiary harps — four larger sets of strings below and two smaller above — spread out over an eighteen foot radius and standing fifteen feet high. Here sound sculptor Ros Bandt desribes the making of the harp.

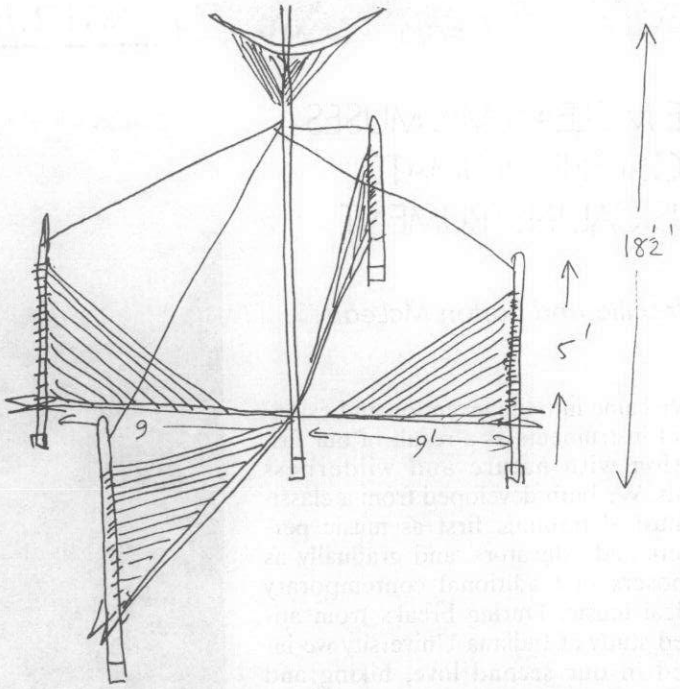
This sound sculpture had a twofold aim to be played by the wind but also by people of all ages. Normally these functions are separate, but I saw no reason why a giant stringed instrument could not fulfill both. The instrument was designed on site, it had twenty-two strings in each of the lower harps and seven in each of the small aerial harps. Four single bass rider strings connected the aerial harps with the lower harps making a total of one hundred and six strings. The lower harps and bass riders all had adjustable tuning pegs.

The construction of the harp had to meet certain musical requirements. The sound needed to be soft because the environment was very quiet and sounds carry over great distances when the land is flat. I also wanted the sound to be subtle in timbre and controllable in pitch so that 'real world music' could be played. In addition, I wanted the sound to transcend cultural definition because the demographic pattern of the Redcliffs area (where the harp was erected) was multicultural. To meet these requirements I chose to use fishing line rather than steel strings, learnt how to use a router to make the elaborate peg boxes and a lathe to turn each peg. These were the technological methods of the skilled craftsperson. I had the opportunity to learn these old technologies because I was collaborating with Steve Naylor, an expert local woodcraftsperson. In order for the harp to be playable, it had to be easy to tune and of appropiate string tension and dimension.

The harp was a result of a long collaboration between Ann Dwyer, the music teacher at Redcliffs High School (where the harp was to be erected permanently after the Sculpture Triennial in Mildura, Victoria), the woodcraftsperson

Right:the author's informal sketch of the layout of the aeolian harp at Redcliffs, Victoria, Australia.

Below:The harp in photographs.



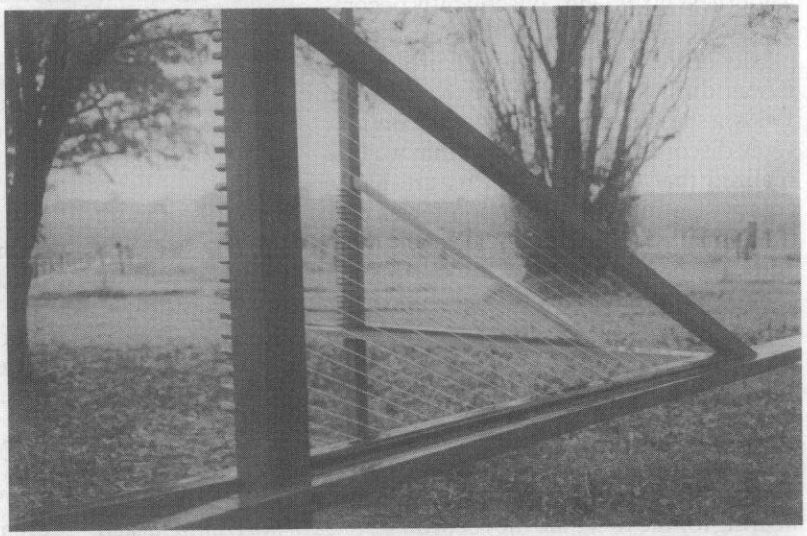
and the sound designer/sculptor myself. Steve had initially instigated the entire project through the local Sunraysia Craft Council. We found that we had to develop words, diagrams, sketches, models and scale experiments just in order to understand each other because we all had different images of the harp and different skills to make it a reality. Specifically technical terminology slowed down this communication process and proved alienating. We knew that later in the project the specialized skill we each possessed would ensure the quality of the product and its use. Of course there were doubts, I was uncertain that the harp would even play. But I had faith that the construction principle I had set in motion was theoretically and acoustically workable.

Steve's contribution in refining the bridges by adding jarrah strips on the sound boards and reinforcing the strings underneath with a solid brass rod rather than individual pins made the project durable as well as visually exciting.

The harp was a delight to play. Strung in pentatonic courses (double-unison strings), it had the shimmering resonance I was looking for. Theoretically I had wanted to tune each of the harps within the harp to a different scale based on a different musical practice: piled-up sevenths and ninths for jazz, dorian mode for ancient, modern chromatic for modern, and pentatonic for non-Western. But the string tension settled best in a pentatonic scale as the wind played the harmonic series. We all agreed about maintaining this particular tuning.

The quadraphonic spatial configuration of the lower harps meant that whichever direction the wind was blowing from, it would play. If you rested your head against the upright mast it would vibrate and amplify the sounds from one harp to another.

Because the sounds were soft, in a beautiful location and playing peacefully in the breeze, the harp developed an aura of its own which we all found very special. At times I cannot bring myself to play it because the wind plays it so beautifully.



Ros Bandt is an internationally acclaimed sound artist, composer, performer and sound sculptor. She has been awarded the Don Banks Composers Fellowship in Australia , as well as the inaugural Cohen Peace prize in the U.S.A. . Currently she is writing a book on sound sculpture in Australia. Ros' music is available from Move Records, Box 266, Carlton South, Victoria 30503, Australia.

THE MCLEAN MIX MUSES UPON THE ULTIMATE MUSICAL INSTRUMENT

by Priscilla and Barton McLean

Barton and Priscilla McLean improvising on the Burgess Shale rocks, placed on a foam pad, in British Columbia. These "ringing rocks" happen to contain some of the oldest fossils on earth (Pre-Cambrian soft tissue fossils formed over 500 million years ago) and were gathered on the side of a glacier near Hamilton Lake and near Burgess Pass in Yoho National Park. They possess deep ringing qualities unlike anything the McLeans have ever heard. Photo by Barton McLean

We came into the invention and extension of instruments as a result of our fascination with nature and wilderness sounds. We both developed from a classical musical training, first as music performers and educators, and gradually as composers of traditional contemporary classical music. During breaks from advanced study at Indiana University we indulged in our second love, hiking and camping in the mountains, canoeing on wilderness lakes, and consequently becoming aware of the vast richness and complexity of the nature sounds all around us. It was during this period in the mid-late 1960s, a season immersed with so many new sonic discoveries on all fronts, that we first realized that the sounds of nature had a creative power and fascination for us equal to sounds of more traditional acoustic and/or electronic media. However beautiful and captivating these new discoveries were for us, the idea of using them as integral parts of composing music came to us only very slowly and painstakingly.

FIRST INFLUENCES AND FIRST INCORPORATION OF NATURE SOUNDS INTO OUR MUSIC

Two events happened around 1973 crucial to our development along this line; access to a large Synthi 100 Synthesizer and hearing for the first time the recording *Songs of the Humpbacked Whale*. The whale songs were a revelation of musical beauty that affected us just as our concern for the degradation of the environment was becoming acute, the early 70s being a very bad time for the entire environmental picture. These two events opened the door for us to use technology to develop the concept of a true nature "instrument."

Then a canoe trip in the Boundary Waters Canoe Area, Minnesota, in July of 1974, during which we were treated to a raging percussive thunderstorm the night long, followed by an astounding loon oratorio on all the surrounding lakes at dawn, led Priscilla to create *Dance of Dawn*, her first major quadraphonic electronic work. We were still learning analog synthesizers, which generated all the sounds for the music, including the "loon chorus" at the beginning. The resulting LP album, produced on CRI Recordings, gave rise to extremely positive reviews and was called "one of the ten best contemporary albums" in an article by Alan Kozin in *High Fidelity Magazine*.

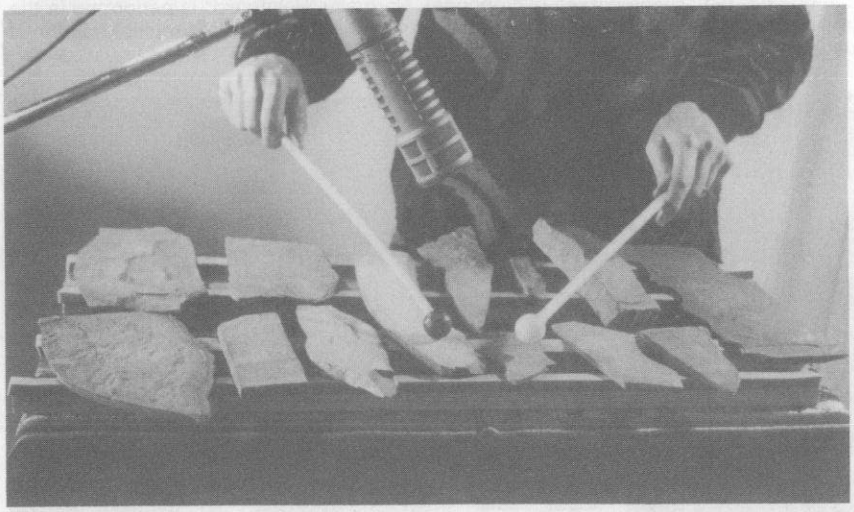
HOSTILITY

While at the University of Texas-Austin in 1976, Priscilla created our first piece using actual recorded animal sounds, with excerpts of whale recordings, taped ocean, and a tuba quartet using very unusual techniques to blend with and play off of the whale sounds to create a symbiotic musical piece favoring the whales, called *Beneath the Horizon*. A solo tuba version of this was performed by Melvyn Poore, virtuosic tubist, at the Gaudeamus Music Festival, Holland in 1979, to the horror and amazement of the Dutch reviewers and unbelieving audience (it was astonishing to us that the audience would stand any amount of dissonant extended musical techniques, as long as they were human-made, but having an ANIMAL – a *Walfisch*! – treated as sophisticated music was unacceptable). This kind of emotionally blatant prejudice against nature sounds as real music was worldwide at the time, we soon discovered, and led us to pose some very important basic questions, important particularly in relevance to our leaving the comfortable world of academia in 1983 to pursue full-time composing and performing with our electro-acoustic multimedia duo The McLean Mix .....

1. Why is the audience so hostile toward nature sounds as classical music (not so much a problem with the other musical genres)?

This article is the first in a series appearing in Experimental Musical Instruments on nature sound in music. Yet to come are an article from nature sound composer Douglas Quinn, a resource list and discussion of issues in nature sound recording and composing by Katherine Girardeau, and a review and guide to nature sound cassettes and CDs by René van Peer.

The Burgess Shale "ringing rocks" in performance, amplified and digitally-processed. This instrument is currently heard in the McLean Mix "Gods, Demons and the Earth" concert.
Photo by Barton McLean



2. What is the basis for all music, why invent new and/or electronic instruments and extend the old ones when there are plenty of "real" instruments available .... ?

A SOLIDIFICATION OF PHILOSOPHY

All of the answers boil down to what has become our philosophy of music, which is passionate enough to propel us through the difficulties and dangers involved:

The ultimate musical instrument is nature. Nature was here first, and has produced and inspired all musics predating writing. It will be here long after we and our calligraphic systems have vanished, and if we wish to extend our visit here on Earth we had better learn to play our discovered instruments in harmony with the world (on all levels) and its endless storehouse of fascinating sounds!

Early musical instruments arose from observing nature. The Japanese *Gagaku* ensemble in an outdoor setting performing its 5000-year old Chinese-derived /music blends with natural sounds so completely that a passing songbird seems to be part of the ensemble. On the other hand, twentieth century Western classical music, with its increasingly complex notation systems, abstract quasi-mathematical thinking and refined traditional instruments, largely divorced itself from the deep well of meaning that is music's origin. In our work with McLean Mix we found a need to invent and extend instruments to produce a less predictably tonal quality – one with"rough edges" that could slide in all the cracks not allowed by the classical thinking but so inherent in nature. This, we hoped, would create a much more meaningful music, yet still be of the high quality and sophistication that classical music has offered for centuries.

What is an instrument? We would define it as a vehicle which produces sounds and has a collection of inherent sound sources that possess an integral commonality. Furthermore, an instrument must be able to be "performed upon" – that is, from its constituent sounds a performer must be able to elegantly play them in real time to realize an artistic goal. A really broad instrument would be a symphony orchestra, a gamelan ensemble or any invented instrumental ensemble that works together to produce music. And so with nature as our broadest of instruments, from an infinite spectrum of natural sound sources we focus a musical experience around a palette of natural flavors that work together, marrying new technology with invented instruments to complement the natural sounds gathered on tape or sampled through a synthesizer.

TECHNIQUES OF COMPOSING WITH NATURE SOUNDS

Although technology would seem on first blush to be yet more divorcement from nature (and it unfortunately too often is just that), it also allows for recording and playing back voices of creatures who are understandably reluctant to be with us (such as wolves, whales, etc.) and who we would otherwise only remember in our mind's ear or try to reproduce even more artificially through instruments, as in the past. The actual nature sound has immense emotional power, and we are careful to preserve many of the bird and animal calls as recorded in the wild. We manipulate only the ones that are more flexible and abstract, such as some birds and crickets, using the wilderness quality to produce a more mysterious effect while preserving the feeling of the wild. Musically speaking, some nature sounds such as crickets, frogs, or locusts have a neutral repetitive quality which invites more manipulative techniques such as transposition or employment of pitch envelopes. On the other hand, the sounds of a Loon, Hermit Thrush or Musician Wren (an incredible Peruvian Amazon songster that finds itself singing away in our recent CD *Rainforest Images*) are so beautiful, so perfect in themselves, that we can best just get out of the way and let them sing. And there is a third category of relevant instruments . These are ones invented by us to fill the gap between traditional acoustic instruments and nature sounds, providing the "glue" which binds these other sonic forces together by contributing elements of gestural, timbral, and pitch control. In short, any sound that

The "Sparkling Light Console," invented to produce brilliant patterns of pulsed colored lights when played by a MIDI keyboard. The custom hardware and software is driven by an IBM XT computer. It is also heard in the "Gods, Demons and the Earth" McLean Mix concert. Photo by Barton McLean

contributes to the wilderness musical expression is fair game for us, be it a tape recording of wind through a barn door, a mosquito recorded in a mayonnaise jar used as resonator, an amplified bicycle wheel resonating on a balsam box, a recorded door squeak that reminds of trees in the wind, or a voice using extended vocal techniques.

MUSIC INSTRUMENT INVENTORS BY DEFAULT

Before we list some of these instruments we "created," it must be emphasized that we do not consider ourselves instrument inventors, and certainly do not pretend to equate our modest attempts with so many of those elegant instruments often featured in this journal. Rather, we seek a certain sound quality, and often the only way we can realize it is to create the instrument – inventors by default as it were. For what it is worth, then, here are some of the instruments we have fashioned to realize our creative ideals:

The Amplified and Processed Bicycle Wheel – adapted for musical use by Barton McLean. The wheel is simply mounted on a balsam wood box, on which is placed a Frap™ contact microphone. This instrument was first used at the commissioned premiere of our full-length concert *In Wilderness is the Preservation of the World* (performed from 1985-1990) in 1985 at the Bowling Green, Ohio University *New Sounds Festival,* in three of the five pieces. The bicycle wheel's spokes are struck with mallets and bowed with violin bows. The struck sounds are a mellow variant of tubular chimes, with extraordinary (and unchangeable) tunings and irregular overtones. Bowed sounds evoke a throaty version of bowed cymbal. The irregular quality of the timbre blends well with all kinds of nature sounds. It must be amplified to be heard, and the raw sound is fed through digital processors of delay and pitch shift combinations to evoke an entire ensemble of sound or just one note holding on many possibilities.

The Clariflute – invented by Priscilla McLean is a hybrid (or lowbrid, according to the classical woodwind performer!) of a soprano wooden recorder body topped by a clarinet mouthpiece and reed, with short extender of garden hose. This instrument was also created for the *Wilderness* concert, used in two of the five pieces, and has since become a standard instrument of our repertoire. It was designed to sound similar to Australian black swans, as it has a much more raucous tone and capacity for sliding, honking, bleeting sounds. It has no recognizable scale, and so allows for more gestural and timbral performance. Through lessening and increasing lip tension, and by biting the reed, one can produce many and varied melodic trips through various harmonic series.

Glacial Rocks from the Cambrian Period – found by both of us near the Burgess Shale formations in Yoho National Park in Alberta, Canada on one of our mountain hikes. As we walked, we noticed that the rocks under our feet were ringing in xylophone-like qualities. We immediately stopped and improvised on several, which were subsequently assembled on foam pads and amplified with an air microphone and occasional processing. Later we developed a piece around them called *Earth Music*, during which we also play ocarinas, recorders, clariflute, sampling keyboard of rock and nature sounds plus piano instrumental sounds, and Priscilla sings, speaks, and uses a wide variety of extended vocal techniques with stereo tape of bass drones and ethereal strings. This is one of five pieces in our latest concert entitled *Gods, Demons and the Earth*, premiered in Melbourne, Australia at LaTrobe University in June, 1990 and with which we are presently touring.

Priscilla and Barton McLean as seen in a typical installation of the audience-interactive environmental media work "Rainforest". Three of the five interactive stations are seen here (from L. to R., keyboard evoking sampled rainforest sounds, amplified and modified autoharp, and digitally-processed microphone). Normally "Rainforest" is performed in the dark with atmospheric green lighting the audience stations and surrealistic multiple rainforest slide projections.
Photo by Ted Berloswski

Bicycle wheel mounted on balsa wood box which is amplified via contact mic and digitally-processed. This instrument was central to the McLean Mix media concert "In Wilderness is the Preservation of the World".
Photo by Barton McLean

Sparkling Light Console – invented by Barton McLean with assistance from Mike Rose and Rodney Peck at the iEAR Program of the Rensselaer Polytechnic Institute. This consists of a large panel of hundreds of pulsing colored lights originally designed to simulate and abstract fireflies blinking on a summer evening. A MIDI keyboard sends note and velocity information to a computer program which initiates light patterns stored in a buffer. The computer then drives the light patterns by outputting upper and lower case letters through the printer port, to be decoded by a custom hardware device which translates the letters into X-Y coordinates and steps up the voltage to light the bulbs. The result is an infinite variety of brilliant displays of pulsed, colored lights. Controls include pattern selection (washes, sweeps, linear, random, comet chase patterns), brightness, color, speed, and gating. Although this is not a "musical instrument" per se, it enhances an electronic piece called *Fireflies*, a staple of our present tour.

RECENT WORK INCORPORATING NATURE

This illustrates the visual counterpart which has been an important ingredient of all our performances. Other visual elements include multiple slide projections fading and dissolving at different rates, and most recently a video called *Rainforest Images*, in a musical collaboration with Panaiotis and video done by Maylasian video artist Hasnul J. Saidon at the iEAR Studios from video shot by Barton McLean in a recent Peruvian Amazon expedition. The purpose for the visual elements, then, is to absorb the whole nature-oriented experience as a gestalt.

The best example of this gestalt is our *Rainforest* hands-on installation, which has been realized at over one hundred colleges, galleries, libraries, conferences, museums, alternate spaces, and schools since its premiere at the University of Wyoming in 1989. The audience is the performer, and five people at a time are invited to experiment at five creative stations, including synthesizers with actual sampled rainforest sounds we recently recorded in the Peruvian Amazon, along with processed microphones and acoustic instruments, all over an ethereal pedal with birds and occasional high suspended strings on stereo tape. A continuous long sequence of moving slides of rainforests photographed by us from around the world frames the darkened installation and provides an atmosphere of primeval wonder. People of all ages perform, often bringing their own instruments to the microphones. Unlike the typical soundscape projects which seek to preserve the integrity of intrinsic sound environments, *Rainforest* seeks to symbiotically blend natural and human sounds in a composite macrocomposition. By directly involving the participant in imitating and expanding already-existing sounds of nature, this creative interaction is not only an artistic experience in itself, but also reinforces the idea that humans and nature are not separate but exist as one entity.

IT WOULD HAVE BEEN EASIER TO WRITE SONATAS

In the last ten years of full-time composing and touring with a strong focus on nature sounds in our work, we have not starved, and as a matter of fact our fear of audiences' reactions has vanished with the recent exponential turn-around in audience interest and enthusiasm, stemming from a genuine, almost fanatical concern now for rainforests and the environment as a whole. We remember well the earlier days of struggle. During a concert in Bergen, Norway in 1983 the local paper proclaimed on the front page, with banner headlines and our picture, "All Hell Breaks Loose in El Dorado" [the name of the theater], due to the fact that the press assumed incorrectly that we were sponsored by Greenpeace, which was boycotting their fish products in the USA due to their deplorable sealing and whaling practices. There were police in the hall that evening, ugly protests, and general hostility. And when we premiered the *In Wilderness is the Preservation of the World* concert in 1985 as the featured guests at the Bowling Green Festival in Ohio, people walked out, refused to sing in the audience-participation section, and were generally hostile and angry. So we have not always had an easy time pursuing our creative ideals. By way of contrast, in 1990, at the last concert of our five-year run of this same work at Ohio University in Athens, the audience almost drowned out the other sounds with their singing and were joyous and enthusiastic. And our current *Rainforest* installation is eagerly sought after, regularly filling up our calendar each year. It has been heartening for us to see the change occurring.

Perhaps our approach to experimental musical instruments and musicmaking with nature can be crystalized in a quotation by John Muir, famous naturalist and founder of the Sierra Club, reflecting in his log after a long day's hiking: "The snow on the high mountains is melting fast, and the streams are singing bank-full, swaying softly through the level meadows and bogs, quivering with sun-spangles, swirling in pot-holes, resting in deep pools, leaping, shouting in wild exulting energy over rough boulder dams, joyful, beautiful in all their forms... When we try to pick out anything by itself, we find that it is bound fast by a thousand invisible cords that cannot be broken to everything in the universe. I fancy I can hear a heart beating in every crystal, in every grain of sand and see a wise plan in the making and shaping and placing of every one of them. All seems to be dancing in time to divine music." (From 1869 Journal entry).

THE MCLEAN MIX: SELECTED DISCOGRAPHY

Rainforest Images (1993), Compact Disc. Capstone Records, #CPS-8617 CD available from Albany Music Distributors, Inc., 98 Wolf Rd., Albany, NY 12205, 1-800-752-1951. The McLeans' definitive nature-based collaborative work including performers and sound sources from around the world. Duration: 48 minutes. Also contains Barton McLean's "Himalayan Fantasy" and Priscilla McLean's "On Wings of Song" from **In Wilderness is the Preservation'of the World.**

"A Little Night Musician" and "Demons of the Night" (1990) from **Visions of a Summer Night** by Barton McLean, on a CD collection of works from the iEAR Studios at R.P.I. on the CDCM Computer Music Series, Vol. 7. Centaur Records, Inc., 8867 Highland Rd., Suite 206, Baton Rouge, LA., 70808.

Following is a selection from the 14 cassette tapes and out-of-print LP recordings which can be obtained (along with a catalog) from the McLeans at their home address at R.D. #2, Box 33, Petersburg, N.Y., 12138 (518) 658 3595. Those with an asterisk are nature-based.

In Wilderness is the Preservation of the World* (1989). Cassette.

The McLean Mix: Electrosurrealistic Landscapes (1985) LP (Opus One Recordings) Includes Barton's "Dimensions VIII for Piano and Tape"*, "The Electric Sinfonia," and Priscilla's "Beneath the Horizon"* and "Salt Canyons" from her piano and tape series **The Inner Universe.**

"The Last Ten Minutes" and "Etunytude" by Barton McLean. (1982) on Folkways **Computer Music from the Outside In.** Includes narrative description by McLean of how the works are composed. Other works by Holmes, Korte.

McLean: Electro-Symphonic Landscapes (1978). LP (Folkways)includes Priscilla's **"Invisible Chariots"** and Barton's **"Song of the Nahuatl".**

"Dance Of Dawn"* by Priscilla and "Spirals" by Barton on a CRI LP album #335 (1974).

ELECTROMAGNETIC PICKUP DESIGN AND CONSTRUCTION TECHNIQUES

By Steve Ball

In an earlier article [EMI Vol. 9 #4, June 1994], I summarized my learning experiences which came through designing and building electromagnetic pickups for stringed instruments. Now I am going to outline the construction of a dual-coil, or "humbucking" pickup in conjunction with this article.

A basic understanding of the theories of electromagnetic inductance and magnetic inductance is of value to the pickup designer. The activity that a guitar pickup is performing when it is being used is called electromagnetic inductance. Radio Shack's *Electronics Dictionary* defines this as, "The voltage produced in a coil as the number of magnetic lines of force (flux linkages) passing through the coil changes." The pickup hybridizes the concepts of electromagnetic inductance and magnetic inductance, creating a sensitive field of flux linkages that are interrupted by the instrument's metal string, creating a change of voltage in the coil.

Some primary choices involved with pickup design involve physical proportions of each component, which comprise the overall structural dimensions of the pickup. These components are the coil, the pole element, and the permanent magnet. These components need to fit together in the enclosure, and it can often be a little challenging to avoid last minute surprises when the coil/pole element/magnet assembly is brought into the enclosure. Figure 1 provides an illustration of the structural components of the pickup I am using as an example for this article. In this design the components within the enclosure are meant to be encapsulated in a two-part epoxy. This is done to protect the thin magnet wire from being severed, and to reduce the amount of oxygen in the coil. It is possible to solidify the coil by other means, such as enamel coating or taping. Some of these techniques can be observed in commercially made pickups.

The pole element is a piece of metal which is in contact with the permanent magnets, and acts as a conveyor of the magnet's force. One edge of the pole element is close to the strings, and there it transmits the magnetic field from the permanent magnet to the area above the pickup, occupied by the strings. Metals used to make the pole element should be magnetically "soft", meaning the metal is of a composition that easily conducts magnetism. The steel that I am using in this model pickup would be more ideal if it had a higher iron content. My purpose in doing this is to show a pickup construction example made from materials that could be acquired by a stop to the local electronics store and K-mart.

The polarity of the magnet(s) is to be recognized, since there are many specialty magnets that are sold without mention of a peculiar polarity. Sometimes the magnet manufacturer will print an "N", or a small dot on the magnet, designating the north pole of the magnet.

Most guitar pickups have a pole element with adjustable pole pieces that screw into an attachment plate at the base, which is in contact with the magnet. This feature allows minute adjustment of the distance between the pole piece and an individual string. The coil is normally wound onto a bobbin, which fits securely around this assembly. As I mentioned in my previous article, as an alternative a coil can be wound directly onto a pole piece fashioned from flat bar steel, available at most hardware stores. It is important that there be no electrical contact between the wire and pole element, so some form of insulation is required. In this case, I am using black electrical tape as an insulating layer. By winding the coil directly onto the pole element, I am eliminating the need to design and construct a bobbin that fits snugly over the pole element. This "virtual bobbin" is the most profound difference which distinguishes my design from conventional methods.

Another choice that has less influence on the physical structure of the pickup, but extreme importance on how the pickup is to behave electromagnetically, is the family of options involved in the coil. Wire gauge determines the amount of resistance the applied current will encounter when it travels through the wire. This has special significance when dealing with either a thin gauge of wire, or an extensive length of wire. In the case of the common guitar pickup, the wire gauge is 42AWG (.0025" dia.), and is wound approximately 6500 times around a bobbin whose length is about 3", indicating the wire is over 3000 feet long. The large number of windings helps the pickup to produce a strong signal, since the voltage that the string movement induces in the coil is proportional to the number of windings. In terms of wire selection, I would not handwind a coil with wire of a finer gauge than 40AWG (keep in mind AWG numerical designations increase as the wire gets smaller). 40 gauge is convenient, not only for the reason of it being tolerable for handwinding, but the fact that its resistance is almost exactly one ohm per foot, enabling the count of windings with an ohmmeter.

In my design, as shown in Figure 1, upper and lower guides placed on the pole pieces provide side walls to keep the windings in place. The height of the pole pieces and the resulting space

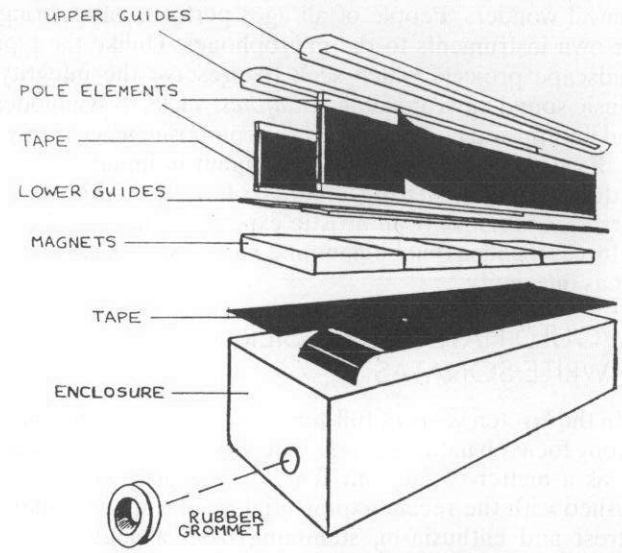
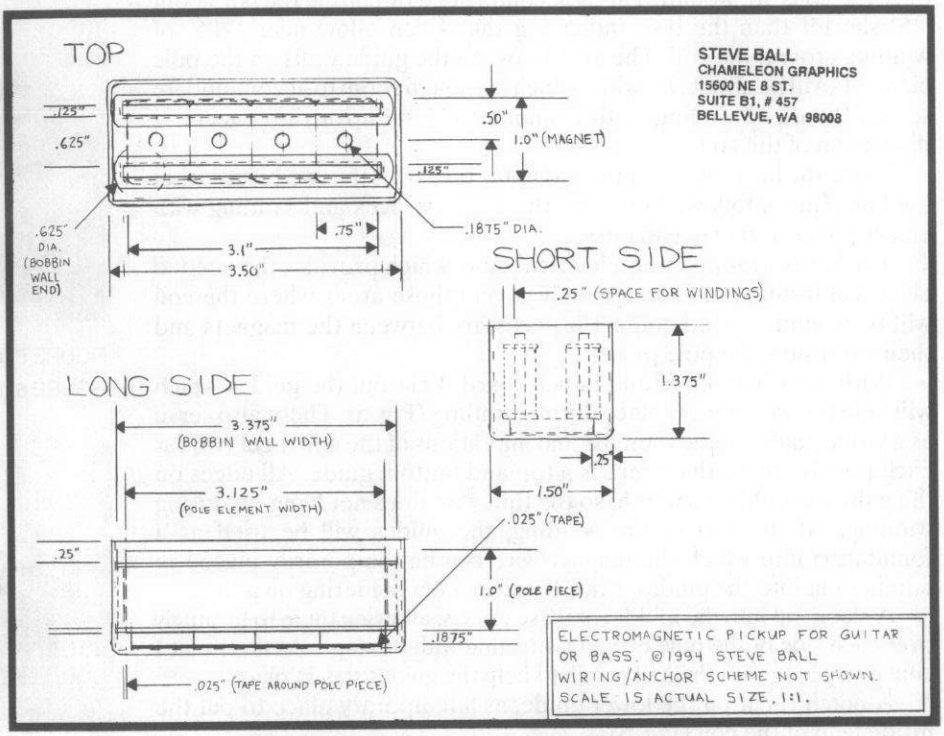


FIGURE 1: Structural components of pickup, shown in exploded diagram. The coil wire (not shown) will be wound over the electrician's tape covering the pole elements, with the guides above and below to keep it in place.

between these guides will determine the dimensions of the coil: A shorter pickup, with the guides relatively close together, will give you a wider coil, as viewed from the top, to accommodate the necessary amount of windings in the narrow space. Used as a pickup, this kind of coil has a more bass-oriented sound. If a coil is designed taller, the windings will occupy more area that is close to the pole element. This characteristic produces a sharp tone. The space available for the coil affects the allowable physical dimensions of the pickup's structural components. Since the coil must be fully contained in the enclosure for proper encapsulation, the maximum height limit for the coil is determined by the depth of the enclosure and the thickness of the magnets. If I had wanted a taller coil in this pickup, I would have needed to find thinner magnets. The enclosure is already of the maximum depth possible to fit into my guitar body. The technical drawing (Fig. 2), shows how I will utilize all of the enclosure's depth that is left after I place the magnets in the bottom.

FIGURE 2: Drawing of pickup showing measurements.



The following is a list of materials I will collect in order to construct the guitar pickup (also shown in figure 3). Consider that another design may need additional materials, or a greater amount of them.

1 spool of 38-40 gauge magnet wire,

1 8 oz. kit of two-part epoxy,

1 tongue depressor and wide-mouthed jar in which to stir epoxy,

1 potting box,

1 length of bar stock steel,

4 magnets,

1 bottle of nail polish to use during winding,

1 roll of electrical tape to shield pole element and magnets from grounded metal enclosure,

2 solder lugs to tie off and solder ends of coil,

1 six inch length of two-conductor shielded microphone or data cable (which approximates the same specs as needed for MIDI applications: light gauge wire [24 GA stranded], and good braided shield, possibly accompanied by foil shield),

1 4"x4" piece of heavy paper board or card stock.

The list of materials for this example includes a metal "potting box." This is an enclosure for the pickup. What you use for the purpose is a matter of personal choice. Being metal, it makes a convenient shield for the pickup, and is of approximate size to fit into a standard, double-coil slot that is routed into the guitar body. In any case, shielding the pickup by using a metal housing or even conductive paint on the inside of a plastic housing is highly recommended, as the battle with noise is not easily won. If I were unable to find a box with the right dimensions, I could try pouring the epoxy into a rubber mold, as outlined in the book, *Animal Magnetism for Musicians*, by Erno Zwaan. The box must be soldered to the outgoing lead cable's braided shield in order to become a shield itself.

The tools required for construction of this pickup (shown in Figure 4) are as follows:

Soldering iron and solder, x-acto knife with no. 11 blade, hacksaw with blade, miter box and clamps, hemostat, one flat file, and 1 sheet of medium grit emery paper.

Beginning with the flat bar stock steel, I measure two lengths which are longer than the width of the bridge, but are not as wide as the length of the potting box. These will serve as the cores for the two coils, and will constitute the pole elements of the pickup.

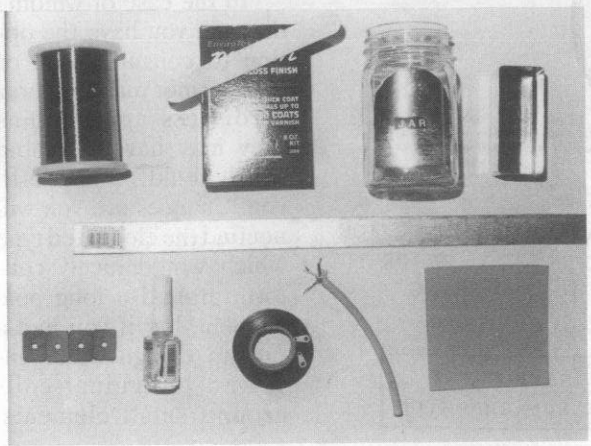


FIGURE 3 (left): Materials needed to construct pickup.

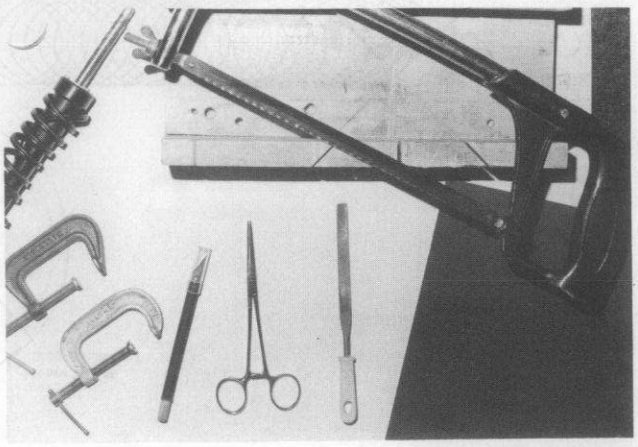


FIGURE 4 (right): Tools needed to construct pickup.

I need to allow for length that will be added to the coil/element assembly once the coils are wound. This is accomplished by cutting the bar about .45" shorter than the box, indicating that I can allow nearly .25" of winding around the coil. The area between the guide walls on the pole elements will be about .75" wide, which is enough room to accommodate several thousand windings with a minimum of buildup on the concentric dimension of the coil.

Using the hacksaw, clamps, and miter box, I cut the two pieces from the bar. This is followed by filing the edge surfaces and sanding with emery paper, removing all burrs.

The bar is wrapped with electrical tape, which provides the needed electrical insulation. The tape only covers those areas where the coil will be wound; a good contact is necessary between the magnets and their extension, the pole piece.

With the x-acto knife and paper board, I cut out the guides which will help the wire into its place during winding (Fig. 5). These also serve as a visual guide for the dimensional limitations of the coil. I cut two for each pole piece, so that there is a top and bottom guide. All edges on the guides should be smooth, so the thin wire does not hang up during winding. At the end of the winding, the guides will be used as a foundation into which the magnet wire can be temporarily placed in notches cut into the guides, prior to permanent soldering on a lug.

A slot is cut into the middle of these guides, allowing them to fit snugly over each side of the pole element, meeting with the tape. At this point I coat everything with the nail polish to help the guides stay in place.

A notch is cut on the lower guide, as a temporary place to put the inside lead of the coil (Fig. 6).

The beginning of the wire is anchored in the notch, and winding begins. I am keeping in mind that I will wind the two coils in opposite directions, as the circuit diagram implies (Figure 7). (The opposite-wound dual-coil arrangement reduces unwanted noise from outside sources in the pickup's output. This is the "humbucking" pickup design concept). I put the spool of wire on the floor, and wind the coil directly above the spool. The

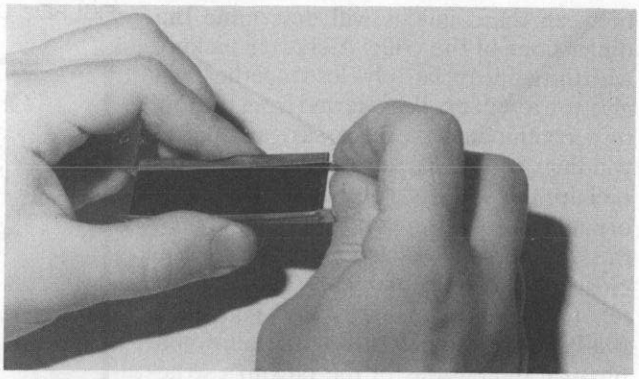
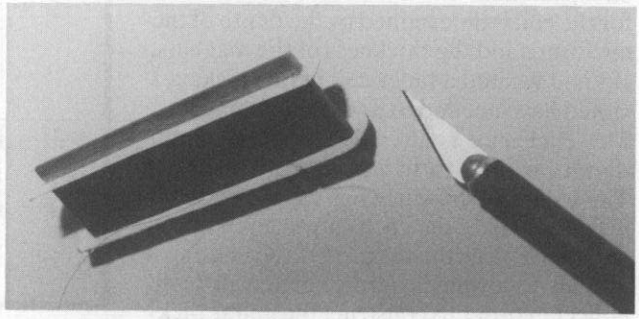


FIGURE 5 (above): Fitting guides onto pole element.
FIGURE 6 (below): Cut a notch, insert end of magnet wire.



windings are periodically coated with nail polish to solidify the coil and eliminate air spaces.

6500 windings is quite an achievement by this method, but the hands seem to be much more efficient than a makeshift winding machine I tried to come up with, using an 8mm film editor. In previous coils, I have made do with only a few thousand windings. 6500 is by no means a minimum, only a goal. This measurement only applies to pickup designs which wind completely around the pole piece area. When you have individual coils assigned to pole pieces that are specific to a single string, the amount of windings is generally much less per coil.

In the case of winding the coil, you have the option to consult a coil or transformer manufacturer to discuss any bobbins they may have available which could be of use to you. Chances are you will not find the elongated type which would nicely conform around a long pole element, but if you had a pickup design which involved individual coils around small elements,

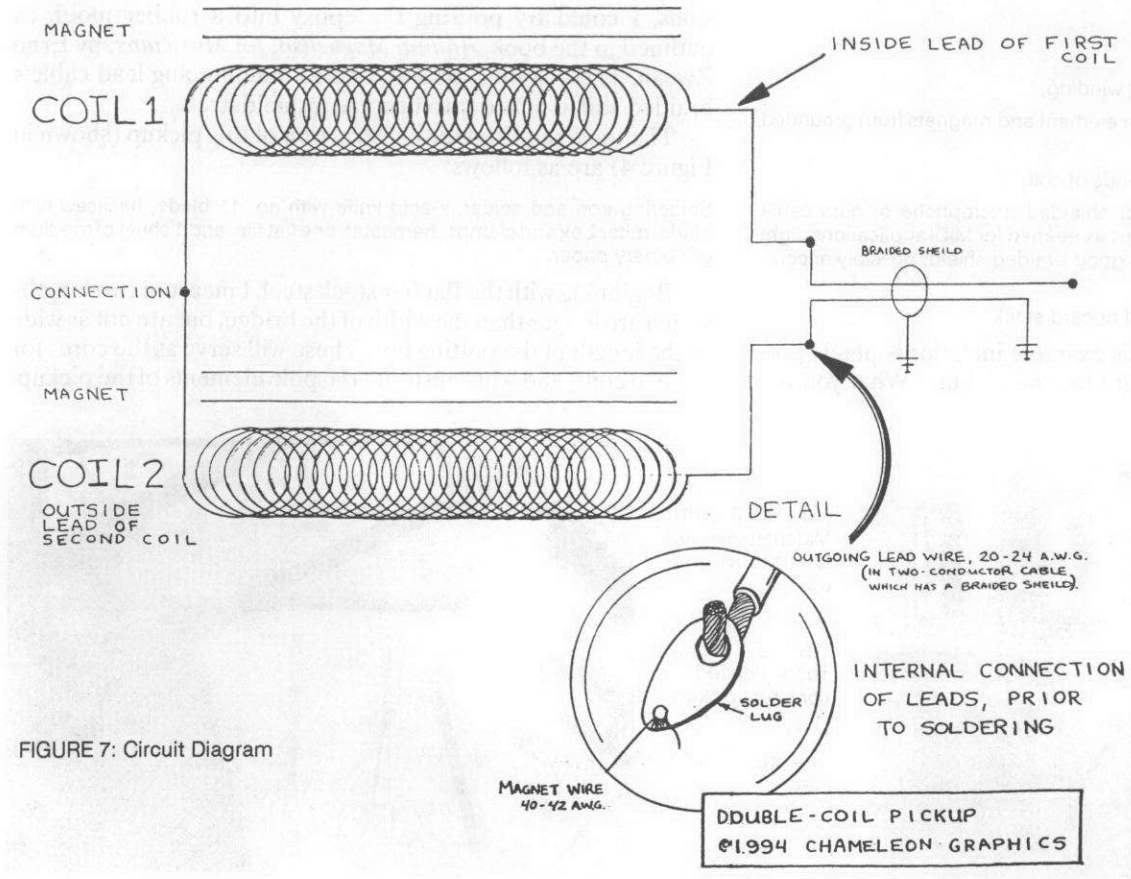


FIGURE 7: Circuit Diagram

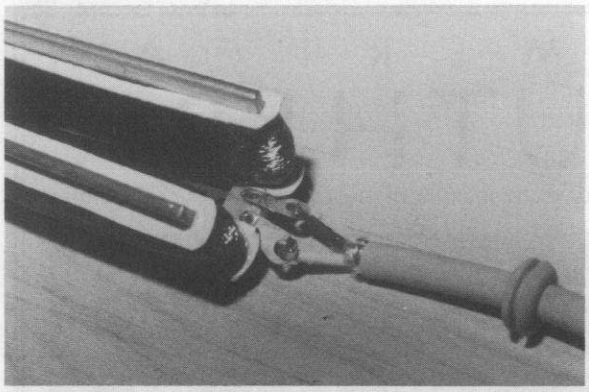


FIGURE 8 (above):Soldered leads.

FIGURE 9 (below): Pouring epoxy.

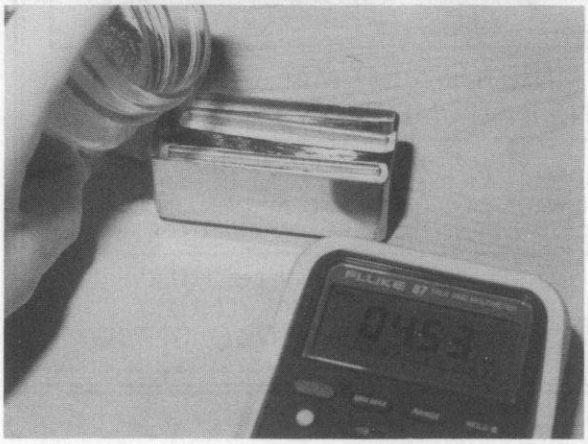


FIGURE 10 (both photos below): Installed pickup.

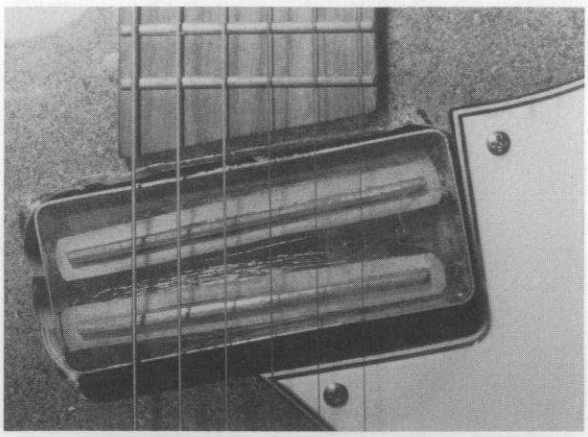
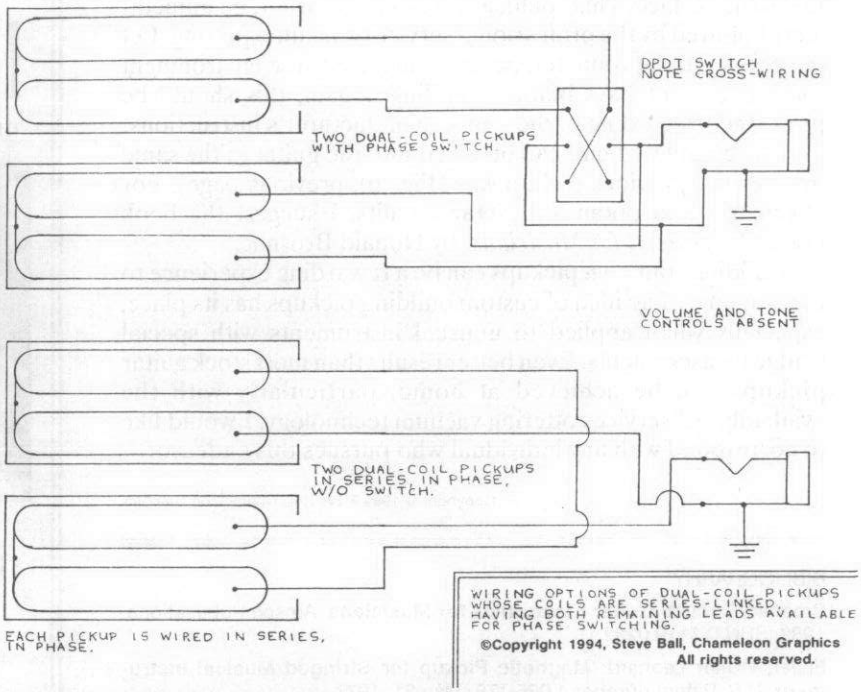


FIGURE 11: Circuit diagrams showing options for wiring pairs of dual-coil pickups, (This is additional information, not referred to in the text, for anyone installing two pickups.)



like the adjustable screws in a standard pickup, there may be many to choose from. Another service that a coil manufacturing facility can provide is "vacuum potting"; an encapsulation technique using a special vacuum chamber. This impressive process completely removes air bubbles from the poured epoxy, provided they have an escape route. Generally, so many bubbles escape out of the epoxy in a potting box that more epoxy needs to be added in order to displace the lost air. Coils treated in this way are especially quiet.

When the winding is complete, the solder lugs are mounted to the bottom guide or another fixed location on the pickup's structural components, as shown in the circuit diagram Figure 7, and in Figure 8. This location needs to be insulated from both the magnet/pole element and the metal box. There is an option to have four leads available (two from each coil), by using a four-conductor lead cable. This would allow for the option of special circuitry that includes series-parallel switching. For this example, I am going to keep the circuitry as simple as possible by wiring the coils in series, but I will use two conductor lead cable if I ever want to use a phase switch with this pickup. Issues of strain relief are addressed through the use of a hole punched in the side of the enclosure which the lead cable is fed through for attachment to the solder lugs. A rubber grommet lining this hole prevents the epoxy from leaking out during the potting stage. The enamel coating on the wire is dissolved by applying and removing solder flux. In addition to this, I shear off the enamel on one side of the wire with the x-acto knife. The wire end is then wrapped many times around the solder lug. After this is accomplished, soldering is performed. The ends of the magnet wire and the pair of wires in the lead cable should have the best contact possible.

By this time, we have the empty enclosure, and all of the other components arranged in a delicate assembly. The pole element/coil assemblies are wired in series, attached to the magnets, and soldered to one end of the lead cable. After feeding the free end of the lead cable through the hole in the side of the enclosure, I hook up the ohmmeter as a monitor of the circuit continuity. If there is any significant fluctuation of the reading during this stage, I want to stop and make sure the reason for the short is identified and corrected. The assembly is then maneuvered gently into the enclosure.

Encapsulation, or "potting" (which implies encapsulating something in an enclosure), is the next step. Follow all manufacturer's instructions carefully in mixing and pouring the epoxy, observing any safety precautions that are given (Fig. 9). Air bubbles in the epoxy can be reduced by

slow, intermittent pouring, which allows the epoxy to fill in crevices. Bubbles are allowed to rise quickly, bursting when they reach the surface. This could, as I described earlier, be immediately followed by the professional service of vacuum potting. Let the epoxy cure at room temperature in a dust-free environment for a couple of days before handling. Again, this should be performed according to the epoxy manufacturer's instructions.

The completed unit can be wired into the guitar in the same manner the previous pickup was (Fig. 10, previous page). For alternative and optimized guitar circuits, I suggest the book *Guitar Electronics for Musicians*, by Donald Brosnac.

Building your own pickups can be a rewarding experience to the beginner. The idea of custom building pickups has its place, especially when applied to unusual instruments with special bridge measurements. Even better results than most stock guitar pickups can be achieved at home, particularly with the availability of services offering vacuum technology. I would like to correspond with any individual who pursues this endeavor.

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Zwaan, Erno; **Animal Magnetism for Musicians**, E Z Tech Publications, 1988 ISBN 90.9001858.1

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Lindsay Publications, P.O. Box 538, Bradley, IL 60915; 815.935-5353
Has a lot of useful information including a book called **Build a Universal Coil Winding Machine. Catalog $1.00.**

MWS Wire Industries, 31200 Cedar Valley Drive, Westlake Village, CA 91362; 818.991-8553
Supplier of many types of magnet wire. MWS offers helpful information in their brochure.

Master Magnetics, P.O. Box 279, 607 South Gilbert, Castle Rock, CO 80104; 800.525-3526
Supplier of magnets in all shapes, strengths, sizes, etc.

Steve Ball also has a videotape available, titled Design and Construction of Electromagnetic Pickups for Musical Instruments, *which shows all construction details mentioned in this article. It is available for $10 postpaid, at the address shown below. The low price can be attributed to its rustic appearance, which came from the use of consumer-grade equipment, and image breakdown occurring from the reproduction process. It was produced with the intention of being an informal presentation addressed to the special interests of those involved with experimental construction of musical instruments. Also included with the video are three technical drawings of the pickup which is built in the video. 58 minutes, VHS NTSC format. Make checks payable to Steve Ball at 15600 NE 8th Street, Suite B1 #457, Bellevue , WA 98008-3917, USA*

Thanks to David Kreimer for technical review of this article.

THE *QING* LITHOPHONES OF CHINA

by Mitchell Clark

I remember a *B.C.* comic strip of many years ago, in which, as I recall, one character questions another, "What's your opinion on rocks?" to which he is given the reply, "Well, they're inevitable." One thing can be said about making musical instruments out of stone: there's plenty of the material around.

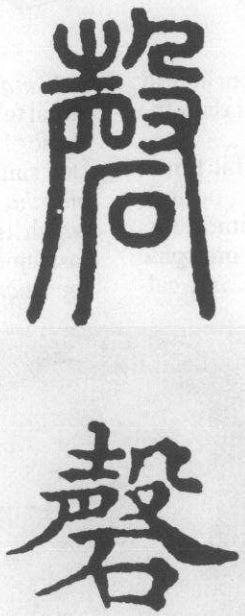
There have, however, been many more cultures which have used stone musical instruments in the past than there are at present: there has been a musical stone age (literally) from which we have historically passed. This is to be regretted, as many kinds of stone, in many forms, are capable of very beautiful sounds. Stone as a material for musical instruments is enjoying a renewed interest, and I will here explore some of the history of instruments made of stone with a focus on a music culture which has one of the richest traditions of lithophones: China.

Lithophone is a general term for idiophonic musical instruments made from stone, and the term as it is usually used implies instruments capable of pitched sounds. For the purposes of this essay, I will use some specific terminology in that I will use the term "lithophone" itself for pitched sounding stones which are fashioned in some way from natural rock by chipping, grinding, or cutting. They may also have a hole drilled in them for suspension. For stones which emit a pitched tone and which are used in a musical context (or a ritual context which involves musical activity), but have not been modified (other than being discovered and, perhaps, moved from one place to another), I shall use the term "rock gong."[1] One identifying feature of a rock gong can be the presence of what are referred to as "chatter marks" or "cup-marks": depressions caused by being struck with another, smaller rock – the "hammerstone."

A survey of the literature includes accounts of rock gongs in Europe, Africa, and the Americas; detailed studies include those of rock gongs in the Canary Islands, Nigeria, and Sweden.[2] In many cases rock gongs were used prehistorically and are now coming to be generally known. And, in the case of Nigerian rock gongs, their ritual use has traditionally been veiled in secrecy and has only recently been documented.[3] Lithophones, on the other hand, seem to have been traditionally centered more in East and Southeast Asia. As will be seen, China has had an extensive tradition of lithophones, called *qing*.[4] In Vietnam ancient lithophones, called *goong lu,* have been unearthed, and in one instance a *goong lu* was datable to *circa* 1500 BC. There is theorizing that other examples of *goong lu* may be the oldest existing lithophones.[5]

Despite the use of rock gongs in prehistoric Europe, lithophones are rare in Western musical traditions. Pliny mentions black stones called *chalcophonos* that sounded like brass,[6] but lithophones perhaps cannot be said to have emerged in the West before the late eighteenth century, when sonorous stones discovered in northwestern England were made into "rock harmonicas," which were used in light-classical and popular music through the nineteenth century.[7]

Why did such an extensive tradition of lithophones evolve in China but not in the West? Limestone and marble, which may be fashioned into pitched lithophones, are certainly not rare in Europe. One answer may lie in the presence of the classical Chinese theory of *bayin*, literally "eight musical sounds." This is the traditional classification system for musical instruments in China, categorizing instruments by their sounding materials of metal, stone,[8] silk, bamboo, wood, skin, gourd, and clay. When instruments of all eight kinds play together, as in the traditional ritual orchestra, the totality of the sounds of nature may be said to be represented. Chinese music has its basis in the elemental materials of nature rather than in the sound of the human voice, as in the West. In theory, the instruments of the ritual orchestra have a certain equality, each playing an essential and balancing role.[9] In the West, there has been a traditional hierarchy, with the voice at the top and instruments below it. Those instruments which have effects like those of the voice – for instance, bowed-string instruments – tend to rank high in the scheme. Percussion instruments traditionally rank low, and perhaps this has contributed to a lack of impetus towards experimentation with materials. In the Chinese ritual orchestra, we find that percussion instruments are the sole representatives of four of the eight *bayin* categories,[10] and *qing* and their corresponding bronze *zhong* bells are examples of how percussion instruments have been of great importance in Chinese music since very early times.

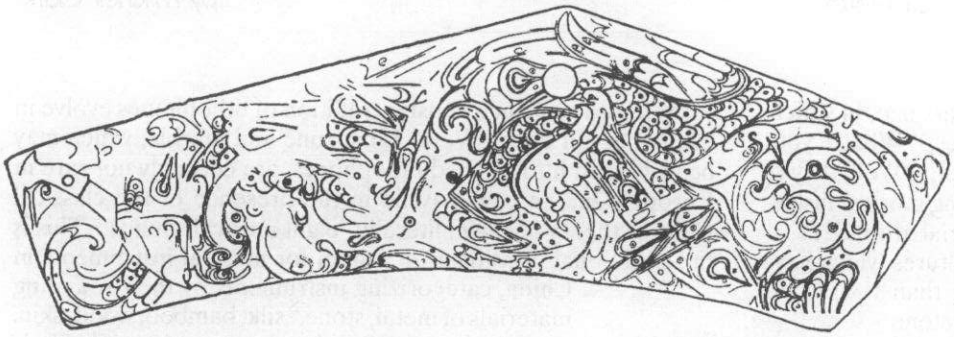


Instruments made of stone have often been associated with ritual.[11] Rock gongs involve a minimum of crafting, being used in their found form, reflecting the mystical quality perceived in the rocks as they are found in nature. This association with ritual is also true of the Chinese *qing*, which for millennia has played a central role in China's ritual music (called *yayue*, literally, "elegant music"), both before the time of Confucius (551-479 BC) and in the context of the Confucian tradition. Traditionally, *qing* and *zhong* have been considered to be the very essence of ritual music.

In discussing the *qing*, I will focus on two historical periods. The archaic/classical period of the manufacture and use of *qing*, namely the pre-imperial periods of the Shang and Zhou,[12] could be said to constitute the *qing*'s "golden age," with the renaissance of the *qing* during China's last imperial period, the Qing dynasty,

At the center of this page are ideographs for **qing**, the Chinese lithophone. The form above is from the first-century AD dictionary **Shuowen,** while a more recent script form appears below. Like many Chinese ideographs, **qing** is made up of other ideographs. To the left is a portion of the ideograph **sheng**, meaning "sound." The markings to the right are generally understood to have evolved from a pictographic representation of a hand holding a mallet. To the lower center is the ideograph **shi**, "stone," which forms the radical (the means of indexing the ideograph as a whole). After the Qing-dynasty **Jinshi Dazidian** ["Dictionary of Ideographs from Bronzes and Stele"], 21.46.

FIGURE 1. A drawing of a late-Zhou-period painted **bianqing** (number 14 of 25) from the state of Chu, excavated at Jiangling, Hubei Province, in 1970. The painted design includes depictions of the mythical **feng** bird. Length of drum 39.8, length of thigh 28, thickness 4 cm; frequency 547.27 cps. After Hubei Provincial Museum, "The Painted Lithophones from Chu Discovered at Jiangling, Hubei and Related Questions" in **Kaogu** 1972.3, page 43.



constituting its "silver age".[13] The following will deal primarily with these two periods as they are better documented than the intermediary periods.

The earliest examples of *qing* date to China's neolithic times, and those unearthed from tombs of the Xia and Shang periods are stone, usually some form of the sedimentary rock limestone. Marble (limestone that has been recrystallized by metamorphic processes) is a prized material. Carbonic limestone and calcareous sandstone are also good materials, being hard and of high density. Marl, a clay-rich limestone, was also used for some Shang-period *qing*, but as marl is not very durable these instruments now show serious disintegration. The use of nephrite jade is later, and was still uncommon during the Zhou period. For the quality of sound it produces, jade is considered the ideal material for *qing*, but it is relatively rare and difficult to work.[14] Concerning the sonic properties of jade, there is a statement attributed to Confucius where it is said that when "struck, the sound [of jade] is clear and extended in duration, ending abruptly."[15]

The written ideograph for *qing* appears on Shang-period oracle bones (ox bones and tortoise plastron used for divination), and perhaps also on one Shang-period *qing* itself.[16] Rendered into English by a variety of terms, such as "sounding stone," "sonorous stone," and even "stone gnomon" (because of the instrument's shape, especially in its Qing-dynasty form), the word "*qing*" is an onomatopoeic term for percussion instruments made of stone or jade.

The form of a *qing* is shown in figure 1, a drawing of a late-Zhou painted *bianqing* from the Warring States-period state of Chu, one of 25 excavated in Hubei province in 1970. Near the top, below the apex, is the hole from which the *qing* is suspended. The longer, narrower end (to the left in this illustration) is the "drum," the area upon on which the instrument is struck with a wooden mallet. The shorter, wider end (to the right) is the "thigh." This general form existed, with minor changes, for some three thousand years. The curve on the bottom, allowing for more separate definition to the drum and thigh, represents what by the late Zhou had been the most recent development in the *qing*'s form. Texts on ritual from this period prescribed specific proportional ratios to the standardized *qing* of the time. In the *Zhouli* ("Rites of Zhou"), the ratios are given as:

width of thigh:	1
length of thigh:	2
length of drum:	3
width of drum:	2/3
thickness:	1/3 of the width of the drum.

The Chu *bianqing* excavated in 1970 follow these proportions fairly well.[17]

There have been several varieties of *qing* through the millennia, the most important of which have been the *teqing* ("single *qing*," also sometimes referred to as *liqing*, "separate *qing*"), and the set of *qing* known as *bianqing* ("arranged *qing*"). Since early times, the musical and ritual functions of these two forms of *qing* have been paired with those of the two principal forms of bronze *zhong* bells: *teqing* with the single-bell *bozhong* and *bianqing* with the set of bells *bianzhong*. A lithophone mentioned in early texts is the *mingqiu*, which translates as "singing jewel," perhaps referring to an instrument made of jade. Other varieties of *qing* have included the *daqing* ("large *qing*"), a single large *qing* also called *xiao;*

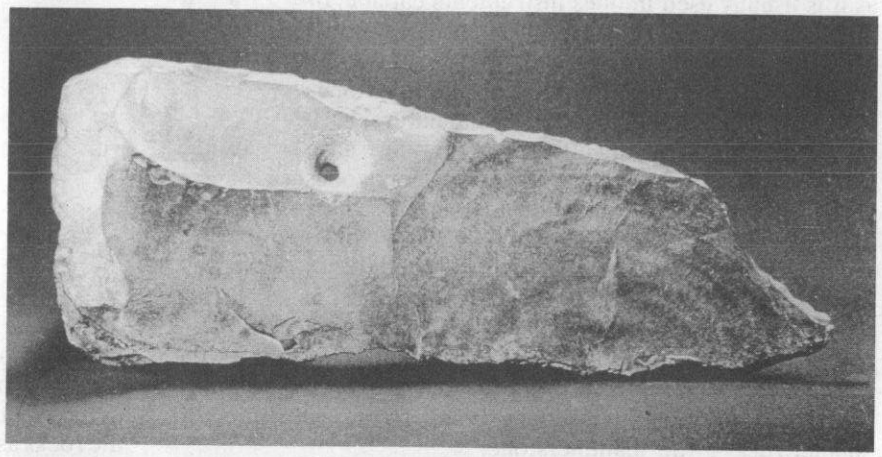


FIGURE 2 (above). Xia-period limestone **qing** excavated at Dongxiafeng, Xiaxian, Shanxi Province, in 1974-76. Length 60 cm. After Research Institute of Music of the Chinese Academy of Arts, **A Pictorial Guide to the History of Chinese Music** (Beijing, 1988), p. 13.

FIGURE 3 (below). Shang-period marble **qing** with tiger design, excavated at Wuguancun, Henan Province, in 1950. 84 x 42 x 2.5 cm; frequency 280.7 cps. After Research Institute of Music of the Chinese Academy of Arts, **A Pictorial Guide to the History of Chinese Music** (Beijing, 1988), p. 15.

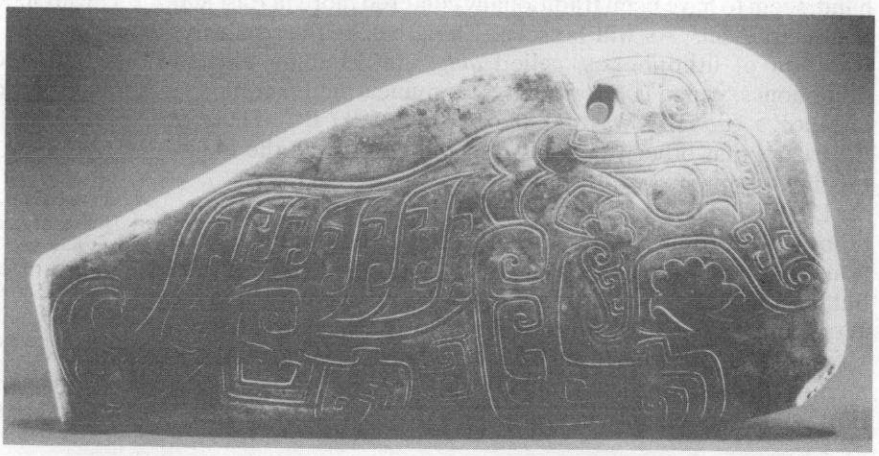
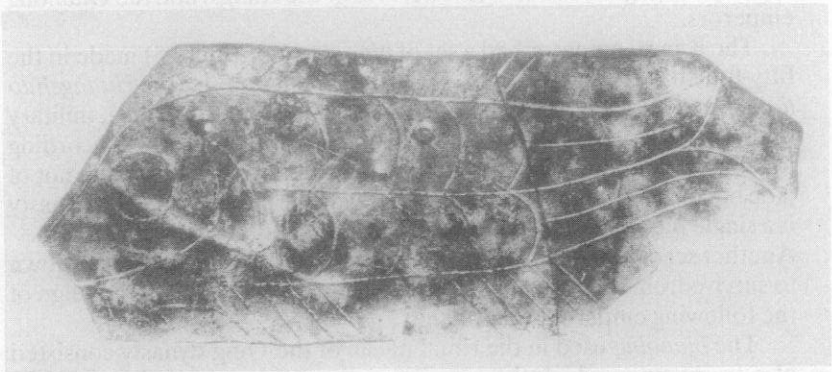


FIGURE 4. Shang-period **qing** with fish design, provenance undocumented. After Research Institute of Music of the Chinese Academy of Arts, **A Pictorial Guide to the History of Chinese Music** (Beijing, 1988), p. 15.



shengqing, *qing* played together with the *sheng* reed organ; *song-qing* ("praising *qing*"); and *geqing* ("singer's *qing*"), to accompany singing.[18] There also have existed varieties of *qing* used as objects of the scholar's studio as well as those used in theater music. Many of these non-ceremonial *qing* were made in odd shapes such as bats, lotus leaves, or clouds.

A few *qing* dating to the Xia, China's earliest historical period, have been excavated in the twentieth century. Each of these early *qing* is roughly chipped from stone (figure 2). It has been conjectured that the *qing* evolved during neolithic times from the triangular stone ploughshare, which may have been used as a signaling device when the ploughshare, with a hole already drilled through it, was suspended and struck.[19] The more numerous *qing* dating to the Shang period include instruments more highly developed in manufacture. Many of these are decorated or inscribed, and zoomorphic designs found on Shang-dynasty *qing* include tiger (figure 3), fish (figure 4), bird, and dragon images. The shapes of early *qing* are variable, but there is a tendency towards a triangular form which would ultimately evolve into the form described above, standardized during the Zhou period. In addition to single instruments, the *qing* unearthed from Shang times include sets of three or five stones. In the case of a tomb in Henan Province, dating to the 12th century BC or earlier, three *qing*, perhaps of a single set, were found together with a set of bronze bells.[20] This suggests that the paired musical functions of *qing* and bells may date back to this early time.

Qing are well-documented in the Chinese Classics, the canonical texts associated with Confucianism. Rich in imagery and in information on early performance practice, passages on *qing* may be found in the *Shu jing* ("The Classic of Historical Documents"), the *Shi jing* ("The Classic of Poetry"), and the *Li ji* ("The Record of Ritual"). These refer to the contexts for and uses of the *qing* during the early to mid first millennium BC, with references to earlier times.

A passage in the *Shu jing* involving Kui, Music Master in service to the legendary Emperor Shun (who is said to have ruled from 2257-2208 BC), is of interest as an early description of playing technique. Two distinct levels of force are used for sounding the instrument, here called *mingqiu*. As Kui states, "I strike the stone, [I] tap the stone." He goes on to say that with his playing, "the hundred wild animals lead one another in dance and the government officials become harmonious,"[21] a reference to the classical Chinese view of the role of music in the harmony of the universe.

In the poetry Classic, *Shi jing*, several descriptions are found of the makeup and function of the musical ensembles in which *qing* were used. In the poem *Gu zhong* ("The Striking of Bells"), the *qing* is combined with the *zhong*, *gu* drum, *se* and *qin* zithers, and *sheng* reed organ to accompany the singing of the *ya* and *nan* odes.[22] As *Gu zhong* is itself one of the *ya* odes, we may assume that it was sung to the accompaniment of the instrumental ensemble it describes. Musical references of this self-reflexive kind are found elsewhere in *Shi jing* texts. In *No* ("Abundance"), it is stated, "The harmonious [instruments] follow the sound of our *qing*."[23] Here is perhaps the earliest reference to what was still to be the ensemble role of the *qing* some two and a half millennia later, being its function of "receiving and transmitting" the notes of the melody it accompanied. In Qing-dynasty practice,[24] the melodic lines of ritual hymns are quite simple, consisting of notes of equal duration, the regular phrases of which are periodically punctuated by percussion instruments. In the accompaniment of the melody, the *bianqing* strikes the melody-note just before the end of the note's duration, helping to coordinate the ensemble for the next melody-note, which is begun with a stroke on the *bianzhong*. The *bianqing*, in this way, helped guide and regulate the continuous flow of the ensemble.

Qing are mentioned in several passages in the *Yue ji* ("The Record of Music") portion of the *Li ji*. This text is a valuable document of the early Chinese conceptions of ritual music and its role in government. Two passages are especially interesting. In one it is stated that the early sages made musical instruments in two stages, the first stage including the more primitive percussion instruments and flutes, and the second stage including the more technologically advanced *zhong*, *qing*, *yu* reed organ, and *se*. Elsewhere, the sounds of five kinds of instruments – bells, sounding stones, zithers, bamboo winds, and drums – are described. Here it is said, *shi sheng qing*, "stone [makes the] sound '*qing*,'" a confirmation of the onomatopoeic nature of the word *qing*.[25]

With the one exception of a reference in the *Li ji* to the single-stone *liqing*,[26] the language of the Chinese Classics does not distinguish numbers of *qing*. By the end of the Zhou period (and therefore by the end of the general period covered by the Classics mentioned above), the set of *qing* called *bianqing* became standardized at sixteen stones. Many *qing* have been unearthed from Zhou-period tombs, and various numbers of stones have been found at different sites. A *bianqing* set of the classically prescribed sixteen stones has not been discovered. The largest find, so far, is 32 inscribed limestone *bianqing*, from the tomb of the Marquis Yi (fifth century BC) of the Warring States-period state of Zeng, in Hubei Province. The fact that exactly twice the number of the standardized 16 stones was found at this tomb is interesting, but there is evidence at the site that the original total was 41 pieces, forming a total range of three and a half chromatic octaves.[27] The 25 Chu *bianqing* mentioned above, decorated with red, yellow, blue, and green paint and in some cases embossed, appear to be the remnants of several sets of *bianqing*, rather than one complete set.[28]

At this time, the stones of a *bianqing* were of uniform thickness, tuning being accomplished by varying the size of the stones, the smaller ones (of lesser mass) being higher in pitch. At some time after the Zhou, perhaps as late as the Song dynasty,[29] there was developed the tuning method of varying thickness while maintaining uniform size, the thicker slabs (of lesser flexibility) being higher in pitch.[30] Detailed tuning of a given *qing* is accomplished by grinding down its thickness to lower the pitch (a tricky procedure) or by grinding down its length to raise the pitch.[31]

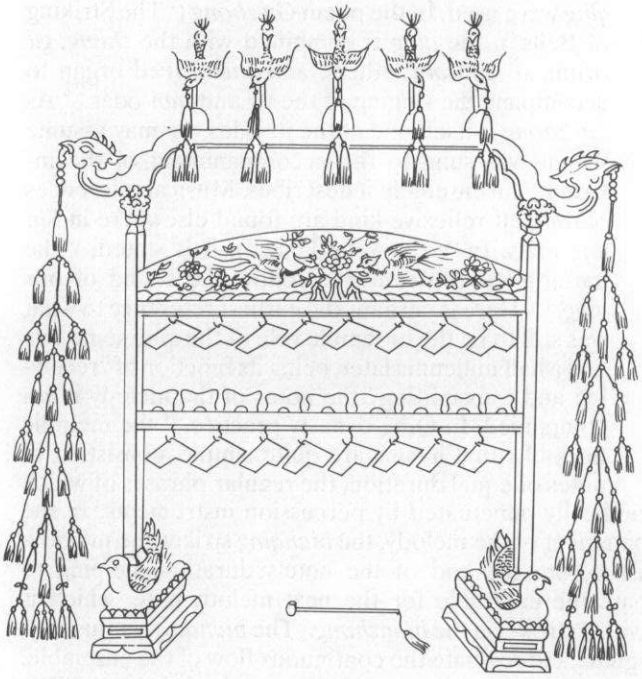


FIGURE 5. Illustration of the **bianqing**, dated 1715 (redrawn by Terese Tse Bartholomew from **Huangchao liqi tushi**, 8.47a).

From the Han dynasty onwards, the number of stones used in *bianqing* fluctuated (as did the number of bells used in *bianzhong*). Beginning with nineteen stones during the Han dynasty, the number varied between fourteen (Northern Zhou dynasty) and twenty-four (Wei Kingdom). During the Tang and Ming dynasties, both sixteen and twenty-four were in use. Sets of sixteen stones had been the standard during a number of the intermediary dynasties, and in the Qing dynasty, during the reign of the Kangxi emperor, the use of the sixteen-piece *bianqing* was again standardized.[32]

Sets of *qing* existed in the Ming dynasty, although no extant example is known. The designs of the Qing-dynasty *qing* were probably based on Ming-dynasty prototypes, but it is unlikely that these prototypes were made of jade, as jade boulders of substantial size were not available to Chinese jade workers during the Ming dynasty. Ming-dynasty sets of *bianqing* were therefore most likely made of hardstone, such as the kind called *Lingbi shi*.[33] The quarrying of jade on a large scale, in the mountains of Yarkand (modern Suoche in Xinjiang Province), made sizable boulders available only in the later years of the Ming, during the late 16th and early 17th centuries.[34]

In 1644 the Manchu from the northeast overthrew the native-Chinese Ming dynasty and established the Qing dynasty, which was to prove to be China's last dynastic period. The Manchu assimilated quickly and the emperors, who were well steeped in the Chinese Classics, began to reinstate some of the ancient Confucian court rituals, which included the musical use of *zhong* and *qing*. This would seem to have been responsible for a renaissance in *qing* making and, along with the availability of Yarkand jade, to account for the many sets of jade *qing* made during the periods of the Kangxi and the Qianlong emperors.

The Kangxi emperor had a set of *bianqing* (see figure 5) made in the fifty-fourth year of his reign, 1715. This set is illustrated in the *Huangchao liqi tushi,* a book detailing the ritual vessels, costumes, insignia, military uniforms, weapons, and musical instruments of the court.[35] According to the description in *Huangchao liqi tushi,* this *bianqing* was made not of jade but of *Lingbi shi*.[36] The earliest known jade *qing* of the Qing dynasty is a single piece from a set of *bianqing* made the following year, in 1716.[37] Another set of jade *bianqing* was made in 1720, and two pieces are known to survive from this instrument. No *qing* have been traced to the reign of the following emperor, Yongzheng.

The *bianqing* used in the ritual music of the Qing dynasty consisted of a frame upon which the *qing* were suspended in two tiers of eight stones each,[38] the frame itself ornamented with tassels and zoomorphic forms. The *bianzhong* followed a similar arrangement. The two poles supporting the *bianqing* rested on carved images of ducks, the *qing* themselves suspended by thick cords of silk dyed in imperial yellow.

By decree of the Qianlong emperor in the eighth year of his reign, 1743, the court ceremonies involving ritual music were reduced to the semi-annual sacrifice to Confucius, with its six-verse hymn.[39] In the temple dedicated to Confucius,[40] the *bozhong* and *bianzhong* are placed on the east side, opposite the *teqing* and *bianqing,* on the west side. These placements of the bells and stones reflect a *yang* association with the easterly direction (specifically in the sense of "birth," as in a sunrise) and with metal, and a *yin* association with the west ("completion," as in a sunset) and with stone. For the hymn to Confucius, the *bozhong* is struck at the beginning of each verse and, as is the case with the *teqing,* which is struck at the end of each verse, it is tuned to the key note appropriate to the month of the ceremony.[41] As mentioned above, the *bianzhong* is struck at the beginning, and the *bianqing* just before the end, of each melody-note of the hymn. These temporal sequences follow the dictum, "When the metal [*zhong*] sounds, the jade [*qing*] answers,"[42] and relate, as well, to the cosmological associations of *yang* and *yin*.

The reign of the Qianlong emperor was the great flowering of the production of jade *qing*. During his reign, successful military campaigns to the west of China brought the main sources for jade, Yarkand and Khotan (modern Hetian) in Xinjiang, under Chinese jurisdiction in 1759-60. Large boulders of green nephrite were transported to Suzhou, China's center for jade carving, and sets of *qing*, numbering more than 160 pieces and consisting mainly of *teqing,* were manufactured in 1761.[43]

FIGURE 6 (immediate right). **Teqing** of the pitch **wuyi** (front), Qianlong period, dated 1761, green nephrite with gold gilt, Asian Art Museum of San Francisco, gift of Avery Brundage, no. B60 J67. 54.5 L x 22 W x 4 D cm.

FIGURE 7 (adjacent, on facing page). Reverse of the Asian Art Museum **teqing.**

The Palace Museum in Beijing has a complete set of 1761 *teqing*, while *teqing* from another set (or sets), also dated 1761, are scattered among museum collections in the United States.

The *teqing* made in 1761 are quite elaborate in decoration, and a *teqing* at the Asian Art Museum of San Francisco is one such example.[44] The front depicts two dragons fighting for a flaming pearl, the center of which has been drilled for the suspension hole (figure 6). Between the dragons are two inscriptions: one horizontal line of text on top reading, "*teqing* number 11: *wuyi*," and seven vertical lines below, giving the date, "Made on the ninth day of the eleventh moon, in the twenty-sixth year of the Qianlong period of the Great Qing dynasty." The dragons and inscriptions appear against a background of golden clouds. On the back, the dragons appear again, reversed, and in between is inscribed a long poem by the Qianlong emperor (figure 7). Here he states the reason for having these *qing* made and says that the jade came from Khotan. In the poem he also, replete with classical allusions, links the role of music to the harmony of the empire. There are altogether six known individual *teqing* dated 1761. Illustrations of a 1761 set of twelve *teqing*, together with descriptions and measurements, appear in the *Huangchao liqi tushi.* Figure 8 shows the *teqing* of the pitch *wuyi,* from the set dated 1761. Jade *qing* were manufactured again in 1764. The Palace Museum, Beijing, has complete set of *bianqing* of this date,[45] and there are four known examples of individual *qing* from another set (or sets) of *bianqing* dated 1764.[46]

The Qing-dynasty *bianqing* and especially the *teqing* are large objects, and were fashioned from huge green nephrite boulders, which had to be flawless to ensure a perfect musical tone. The Qing-dynasty scholar Xu Song wrote of the production of *qing* in his *Xiyu shuidao ji* ("River Systems of the Western Regions," published in 1823).[47] Here he mentions that in 1764 more than two and a quarter tons of jade from the Mirtai mountains in Yarkand were dispatched to the emperor with the express purpose of making *qing.* Based on this source, it may be concluded that the jade for the 1764 *bianqing* came from Yarkand. Xu Song also says that "the jade produced [at Yarkand] is said to be of the best quality, of brilliant color and strong substance and to emit the clearest sound when struck with the hammer, vibrating for a long time till the sound stops abruptly in the way characteristic of jade."[48]

With the dissolution and ultimate fall of the Qing dynasty, bringing an end to imperial China in 1912, the use of musical instruments that were specific to ritual music fell into a sharp decline. While some instruments of the ritual orchestra had repertoires outside of this ensemble (such as those of the *qin* zither and the *sheng* reed organ), the *qing's* primary use was in the Confucian ritual. One observer noted that by the last quarter

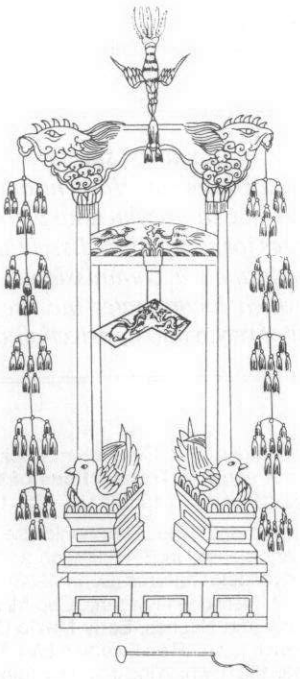
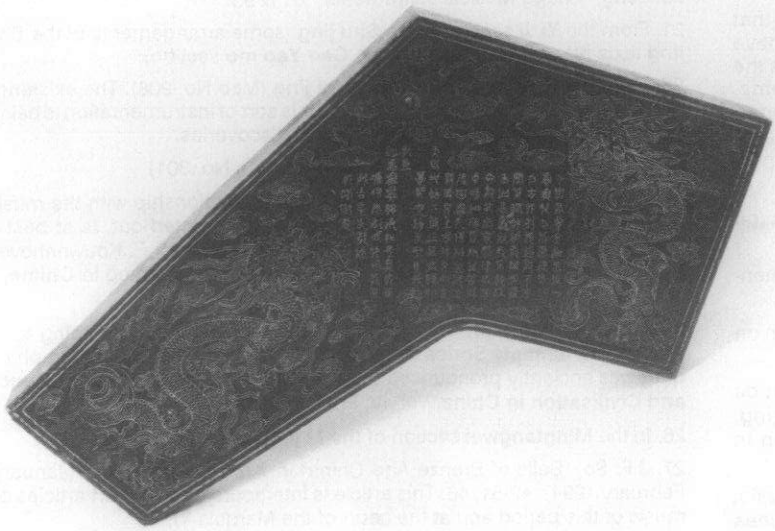


FIGURE 8. Illustration of the **teqing** no.11, dated 1761 (redrawn by Terese Tse Bartholomew from **Huangchao liqi tushi**, 8.45a).

of the nineteenth century, *bianqing* sets were being broken up and the individual *qing* were available for sale.[49] The ritual music was played infrequently during the Republican period, and survives today (in a rough form) in Taiwan, Republic of China. This the only traditional Chinese context in which one will hear *qing* played today.

In Korea, the lithophones *p'ong'gyong* (equivalent to the Chinese *bianqing*) and *t' ukkyong* (equivalent to the *teqing*) are used in the ritual music *aak* (the Korean reading of *yayue*, "elegant music") and the court music *tangak* ("Chinese music"), both of which were derived from Chinese models. These instruments were originally introduced from China in 1116, as part of a gift of Chinese ritual-music instruments from the Song-dynasty emperor. At present they are made of a form of calcite, white with a green hue, called *kyongsok* (literally, "chime stone").[50] Through research and performance, the National Classical Music Institute in Seoul maintains the tradition of the surviving repertoires of *aak* and *tangak.*

There have been attempts in the People's Republic of China to reconstruct ceremonial and court music of the past for concert-hall performance. One attempt uses *bianqing* of the traditional shape as well as an instrument using the traditional name of *bianqing*, but which, judging from its sound as demonstrated in recordings, seems to be an instrument in which stone (?) bars are arranged as on a Western xylophone.[51] Despite the claim to being a reconstruction of Chinese music of antiquity, music using this kind of *bianqing* is essentially modern in concept and execution. It is to be hoped that future efforts (in both the Republic of China and the People's Republic of China) will result in better-informed performances of the rich ritual-music tradition of China, of which the *qing* plays an essential part.



This article is in memory of Harold Russ Nace (1921-1993), who instilled in me his love of rock and mineral collecting in the wilder parts of Rhode Island.

Mitchell Clark is a musicologist specializing in Chinese classical music, as well as a composer. His central interest is the Chinese seven-string zither qin*, upon which he performs. As a composer, he frequently writes for percussion. Essential Music, of New York City, recently performed a commissioned work of his for five percussionists, which incorporates the use of the Chinese classification system of* bayin *into its selection of instruments.*

NOTES

1. This follows the usage of F.P. Conant, in "Rocks That Ring: Their Ritual Setting in Northern Nigeria" in **Transactions of the New York Academy of Sciences,** II/23/2 (December 1960): 155-162, 156.

2. R. Álvarez and L. Siemens, "The Lithophonic Use of Large Natural Rocks in the Prehistoric Canary Islands" in E. Hickmann and D.W. Hughes, eds., **The Archaeology of Early Music Cultures** (Bonn, 1988): 1-10; Conant, "Rocks That Ring" (see above); O. Henschen-Nyman, "Cup-Marked Sounding Stones in Sweden" in Hickmann and Hughes, **Early Music Cultures**, 11-16. This last article makes reference to an LP on Swedish EMI, **The Sounds of Prehistoric Scandinavia** (EMI 1361031), which includes recordings of Swedish rock gongs.

3. Conant, "Rocks That Ring," 158.

4. The Pinyin system of romanization of Mandarin Chinese will be used in this essay, although in some of the cited sources, such as Chuang Pen-li, there will be found the older (but not obsolete) Wade-Giles system. The Wade-Giles equivalent of the Pinyin romanization "**qing**" is "**ch'ing**," and the pronunciation of the word can be closely approximated by English "ching."

5. Trân Van Khê, "Goong lu" in Stanley Sadie, ed., **The New Grove Dictionary of Musical Instruments** (London & New York, 1984), Vol. 2, 67-8.

6. S. Marcuse, **A Survey of Musical Instruments** (New York, 1975), 31.

7. One of the groups performing on such instruments was the celebrated Till Family. See Dr. A.M. Till, "The Till Family Rock Band" in **Experimental Musical Instruments,** 7/5 (April 1992): 12-13.

8. In China there has traditionally been a distinction between stone (**shi**) and jade (**yu**), considered to be mutually exclusive categories of substances. Jade is, however, included in the **bayin** category of stone, and for the purposes of ritual music the two terms would seem to be generally interchangeable. Therefore, the names of specific types of **qing** did not seem to be dependent on whether the instrument was made from stone or jade. One exception to be found is a definition in the **Cai zhuan**, the chronicles of the late-Zhou-period state of Cai: "The **qiu** is a **qing** made of jade. The **qing** [proper] is a **qing** made of stone." (Quoted in Ceng Yongyi, **Yili yueqi kao** {"A Study of Musical Instruments in the Book of Ritual"; Taipei, 1971}, 36.) The **qiu** in question here is represented by a different Chinese Ideograph than the **qiu** ("round jewel") of **mingqiu**, to be mentioned later in the present text.

9. In the overall picture of Chinese music, however, we do find that certain instruments, such as the **qin** zither, of the silk category, have extensive repertoires outside of the ritual orchestra. Others, such as the **zhu** and **yu** percussion idiophones, of the wood category, have extremely limited (yet still necessary) roles in the ritual orchestra and no repertoire whatsoever outside of it. In addition, wood as a sounding material is not as well represented in the Chinese instrumentarium as is, for instance, silk.

10. I.e., Metal (**zhong** bells), stone (**qing**), wood (**zhu** and **yu**), and skin (**gu** drums).

11. Cf., for instance, Conant, "Rocks that Ring," 158-159, and Henschen-Nyman, "Sounding Stones," passim.

12. A chronology of the major periods and dynasties of China is given on this page.

13. The name of the dynasty, Qing (meaning "pure"), will in the text be in roman type and with an initial capitalization to distinguish it from **qing**, the name of the instrument, which in the text will be italicized and in lower case.

14. Tong Kin-Woon, "Shang Musical Instruments," Part I in **Asian Music,** 14/2 (1983): 17-182, 100; Chuang Pen-li, **A Study of the Stone Chimes Preserved in the National Museum of History** (Taipei, 1968), 16.

15. From the **Pingyi** section of the **Li ji.** I have not had the opportunity to confirm this statement's claim on an actual jade **qing.** My own experiments with a roughly fashioned **qing** which I made from marble (sounding the pitch **a-flat**) produced a muted but clear, and quickly fading, tone. **Qing** may be heard on a recording of the ceremony in homage to Confucius on his birthday, recorded on 28 September 1987 in Tainan, Taiwan (**Music of Man Archive: Taiwan, The Confucius Temple Ceremony;** Jecklin-Disco JD 652-2; 1991). I assume these **qing** are made of marble or limestone, and they do (what one can hear of them) have a quickly fading tone.

16. Cf. Tong, "Shang Musical Instruments," 82-3.

17. Hubei Provincial Museum, "The Painted Lithophones from Chu Discovered at Jiangling, Hubei and Related Questions" in A. E. Dien et al, eds., **Chinese Archaeological Abstracts,** Vol.3 (Los Angeles, 1985): 677-685, 679. The article originally appeared in Chinese in **Kaogu** 1972.3: 41-48. See also Tong, "Shang Musical Instruments," 103.

18. Chuang, **A Study,** 2-5.

19. Tong, "Shang Musical Instruments," 69-76.

20. Tong, "Shang Musical Instruments," 81 & 95.

21. From the **Yi Ji** section of the **Shu jing** (some arrangements of the **Shu jing** texts place this passage in the **Gao Yao mo** section).

22. From the **Xiaoya** section of the **Shi jing** (Mao No. 208). The existence of Zhou-period musical ensembles with this sort of instrumentation is being confirmed by present-day archaeological discoveries.

23. From the **Song** section of the **Shi jing** (Mao No. 301).

24. The Qing-dynasty practice, in terms of its relationship with the music of the distantly earlier Zhou period, it must be pointed out, is at best a "reconstruction of a reconstruction." (See the review by F. Kouwenhoven of the **Taiwan, The Confucius Temple Ceremony** recording in **Chime,** 5 {Spring 1992}: 161-2, 161.)

25. From the third part of the **Yue ji** section of the **Li ji.** According to B. Karlgren, **Grammata Serica Recensa** (Stockholm, 1957), the idiograph for **qing** was anciently pronounced **k'ieng.** (Quoted in J. Needham, **Science and Civilisation in China,** Vol. IV, Part 1 {Cambridge, 1962 }, 153.)

26. In the **Mingtangwei** section of the **Li ji.**

27. J.F. So, "Bells of Bronze Age China" in **Archaeology,** 47/1 (January/February 1994): 42-51, 46. This article is interspersed with short articles on music of this period and at the court of the Marquis Yi.

Chronology of the Major Periods and Dynasties of China

Xia	ca. 22nd - 17th centuries BC
Shang	ca. 17th - 11th centuries BC
Zhou	ca. 11th century - 221 BC
Warring States	476 - 221 BC
Qin	221 - 206 BC
Han	206 BC - AD 220
Three Kingdoms	AD 220 - 265
Wei	220 - 265
Western Jin	265 - 317
Northern & Southern Dynasties	386 - 587
Northern Zhou	557 - 581
Sui	581 - 618
Tang	618 - 906
Song	960 - 1280
Yuan	1280 - 1368
Ming	1368 - 1644
Qing	1644 - 1912
Kangxi emperor	1662 - 1722
Yongzheng emperor	1723 - 1735
Qianlong emperor	1736 - 1795
Republic of China	1912 - 1949 (continuing in Taiwan)
People's Republic of China	1949 - present

28. Hubei Provincial Museum, "The Painted Lithophones," 679 (of **Chinese Archaeological Abstracts).**

29. A.C. Moule, **A List of the Musical and Other Sound-Producing Instruments of the Chinese** (Buren, The Netherlands, 1989), 31. (Originally published in 1908.)

30. A.R. Thrasher, "Qing(i)" in **The New Grove Dictionary of Musical Instruments,** Vol. 3, 173.

31. Tong, "Shang Musical Instruments," 103.

32. Kuiliang, **Honggong jingshi** (second edition, 1883), from Chapter 2, **Zhonghe shaoyue,** 9b (this information refers to the **bianzhong** bells; on 12a, referring to the **bianqing,** it says "same as the bells").

33. **Lingbi shi** ("stone from Lingbi," in Anhui Province) was to remain a standard material for **qing,** although jade, as we shall see, was the material of choice for imperially commissioned **qing** during the Qing dynasty. See A.C. Moule, **A List,** 32.

34. J.C.Y. Watt, **Chinese Jades from Han to Ch'ing,** (New York, 1980), 27.

35. This book is described in M. Medley, **The "Illustrated Regulations for Ceremonial Paraphernalia of the Ch'ing Dynasty"** (London, 1982).

36. **Huangchao liqi tushi** (originally printed in 1766; reprint, Taipei, 1976), Vol. 8, 47-48.

37. New York, the Metropolitan Museum of Art, no. 03.15.1; green nephrite with gilt; 11 1/2 H x 20 W x 1 T in. See L. Roberts, **Treasures from the Metropolitan Museum of Art** (China Institute, exhibition catalogue; New York, 1979), No. 26.

38. The **bianqing** (as well as the **bianzhong**) of the Qing dynasty covers a range of an octave and four semitones. The pitches, or **lü,** are as follows, chromatically from low to high: 1, **beiyize**; 2, **beinanlü**; 3, **beiwuyi**; 4, **beiyingzhong**; 5, **huangzhong**; 6, **dalü**; 7, **taicou**; 8, **jiazhong**; 9, **guxi**; 10, **zhonglü**; 11, **ruibin**; 12, **linzhong**; 13, **yize**; 14, **nanlü**; 15, **wuyi**; and 16, **yingzhong**. The pitches of the **bianqing** and **bianzhong** are arranged in this manner:

upper row (**yang lü**):	15	13	11	9	7	5	3	1
lower row (**yin lü**):	16	14	12	10	8	6	4	2

The exact frequencies assigned to these Chinese pitch names changed frequently. A surviving set of pitch pipes produced in or before the 52nd year of the Kangxi emperor's reign (1713) yields a slightly sharp E_5 (a tenth above middle C) for the primary tone **huangzhong** ("yellow bell"). Wan Yi, "Pitch System and Pitch Pipe of the Qing Court" in **Wenwu** 1986.7: 77-80, Table 1 on page 78.

39. W. Laade, notes to **Taiwan, The Confucius Temple Ceremony**, 6.

40. In the later Qing dynasty, a Confucian temple was to be found "in every District city of the Empire, besides a special one in each Department." G.E. Moule, "Notes on the Ting-chi, or Half-Yearly Sacrifice to Confucius" in **Journal of the China Branch of the Royal Asiatic Society,** 33 (1901): 120-156, 120. G.E. Moule's observations of the Confucian sacrifice, in Hangzhou, took place in 1891 and 1898.

41. The pitches of the Qing-dynasty **teqing** and their corresponding months of the lunar calendar are as follows, chromatically from low to high: 1, **huangzhong** – 11th month; 2, **dalü** – 12th month; 3, **taicou** – 1st month; 4, **jiazhong** – 2nd month; 5, **guxi** – 3rd month; 6, **zhonglü** – 4th month; 7, **ruibin** – 5th month; 8, **linzhong** – 6th month; 9, **yize** – 7th month; 10, **nanlü** – 8th month; 11, **wuyi** – 9th month; and 12, **yingzhong** – 10th month. With the 1743 decree of the Qianlong emperor limiting the rituals to the semi-annual Confucian sacrifice, only two pitches of **teqing** would have been used (**jiazhong** for the spring sacrifice and **nanlü** for the autumn sacrifice), although full sets continued to be made.

42. Based on a statement of the fourth-century BC Confucian philosopher Mencius, to be found in the **Wanzhang** section of the book bearing his name (in Chinese, **Mengzi).**

43. Long Xiuhua, "Biyu teqing" ("A **Teqing** of Green Jade"), **Gugong bowuyuan cangbaolu** ("A Record of Treasures in the Palace Museum;" Hong Kong, 1985), 250.

44. Asian Art Museum of San Francisco, gift of Avery Brundage, no. B60 J67; 54.5 L x 22 W x 4 D cm.

45. The Palace Museum, **Art Treasures from Birthday Celebrations at the Qing Court,** (Hong Kong, n.d.), unpaginated.

46. One of these, of the highest pitch, **yingzhong,** may now be found in the Walters Art Gallery in Baltimore. This **bianqing** is the focus of T.T. Bartholomew and M. Clark, "The Walters Art Gallery 1764 Jade **Qing** Lithophone and Related Pieces" in **The Journal of the Walters Art Gallery,** 49/50 (1991/92): 131-140. Detailed information may be found there on the documented jade **qing** of the Qing dynasty, many of which are found in collections in the United States. For the **Journal** article, Ms. Bartholomew (Curator of Indian and Himalayan Art at the Asian Art Museum of San Francisco) and myself (formerly Assistant Coordinator of Outreach and Public Programs at the same institution) contributed the art-historical and music-historical portions, respectively. These, with the permission of the Walters Art Gallery, are drawn upon for the present **EMI** article. I have taken the opportunity to correct a few details for the present article, particularly as regards the citation in the present note 32. I would also like to gratefully acknowledge Ms. Bartholomew's permission to make use of her research on Qing-dynasty **qing.**

47. S.H. Hansford, "Jade and Jade Carving in the Ch'ing Dynasty" in **Transactions of the Oriental Ceramic Society,** 35 (1963-64): 32.

48. H.R. Bishop, **Investigations and Studies in Jade,** (New York, 1906), Vol. 1 24-25. Note that Xu Song's description is directly modeled upon the saying of Confucius mentioned above; we'd have to hear examples of the 1764 **bianqing** to confirm the accuracy of his analysis.

49. J.A. Van Aalst, **Chinese Music** (Shanghai, 1884; reprint, New York, 1964), 51.

50. Robert C. Provine, "P'yon'gyong," in **The New Grove Dictionary of Musical Instruments,** Vol. 3, 164. On the recording **Korean Court Music** (performed by the Orchestra of The National Music Institute, Seoul, Kim Ki-su director; Lyrichord LYRCD 7206), the **pyon'gyong** is demonstrated on track 10, as well as being heard in the ensemble on tracks 1-3. The **t'ukkyong** is heard on track 2.

51. This instrument may be heard on the piece "Flowing Streams" (the 4th section of track 4) on **The Imperial Bells of China** (performed by the Hubei Song and Dance Ensemble, on Fortuna Records 17075-2; 1990). What appear to be traditional **qing** may be heard as accompanying instruments elsewhere on the album.

INTERIM REPORT

By Colin Hinz

ACTIVITIES TO DATE AT ASFi MUSIC WORKS

ASFi Music Works is a collective of one working in various areas of music research and instrument making under the direction of Colin Hinz. It also serves as an independent cassette label and publisher. This article was originally written as a report to ASFi supporters.

CONTENT

"George Mantor had an iris garden, which he improved each year by throwing out the commoner varieties. One day his attention was called to another very fine iris garden. Jealously he made some inquiries. The garden, it turned out, belonged to the man who collected his garbage."

– John Cage, *Indeterminacy*, 1958.

John Cage's spirit presence will be passing through this journal on a frequent basis. I'm not going to bother with wordy explanations nor with weepy eulogies. I'll let you figure it out. I'll just mention that i was quite taken aback by Cage's death. Funny, that. I guess i sort of hoped he'd live on forever. Well, i guess he does, just not in the corporeal sense anymore.

RE-CAP

I've been noodling around with noisy electronics and other sorts of (anti-)musical aberrations for a few years now. Nearly everything i do involves "mature" and recycled technology. If you're hoping for comments on the latest techno-wonder synths, or for commentaries on hot new digital signal processing techniques, best you toss this into the fire and go buy the latest issue of *Electronic Musician*. I'll be doing some experiments with DSP one of these days, but by the time that happens i'll be buying the chips at my favourite surplus store. Or maybe not.

I've been working with noisy electronics since 1987, when i built a ring modulator to make merry mayhem out of radio broadcasts. I started doing tape experiments in 1989, and assaults on vinyl since 1990. I'm starting to move on to the next big bunch of audio tomfoolery; life just won't be the same afterwards. Beware the advance of the robot plunderphones.

CYBERSERIALISM

My music dictionary defines serialism thusly: "A method of composition in which one or more musical elements is subject to ordering in a fixed series. Most commonly the elements so arranged are the 12 pitch classes of the equal-tempered scale." Humans keep track of numbers in many radices; 12 is just one of them. The modern digital computer is constrained to base two arithmetic. Sixteen is two to the fourth. So it follows that, when machines become serialists, they abandon the 12-tone row and work with 16 notes instead.

The original Cyberserialist is the Piandemonium, an instrument i built for the Avant-Garde Museum of Temporary Art in Madison, Wisconsin. It was constructed for the occasion of the 1989 Festival of the Swamps, and it appeared in the Swamps Parade until the wheels fell off. Aside from that mishap, it has proved to be a pretty permanent piece of temporary art, having since then survived a two hour drive to West Lima, Wisconsin, where the AGMTA is currently headquartered.

Getting back to it all, now. The Piandemonium started off as the "harp" left behind from a piano cannibalizing project. To this i added crude hammers activated by solenoids, which are driven by a hand-built mass of electronics. The electronics activate the hammers one at a time in a pseudo-random sequence. Careful listening will detect a long pattern. To be precise, the instrument plays a sequence of 4096 notes of equal duration. The pattern is in actuality appropriated computer code, previously used to run a word processor, I think. I built the electronics so that different programmed memory chips could be used, thus allowing experimenting with the sequence. I've found that using a chip containing mostly blank data causes long sequences of the same note to be played, punctuated by brief chromatic ramblings. A progression from cyberserialism to junk-sculpture minimalism.

ELECTROCAGEISM

Just as human-based musics have advanced from Schoenberg to John Cage's chance operations, so does Cyberserialism advance towards Electrocageism. Complex electronic systems can be taken out of their intended usage (such as a control computer for a microwave oven) and treated as a black box. A bunch of signals go in, and a bunch of signals come out. The output signals can be used to control oscillators and amplifiers or perhaps more complex devices like a Piandemonium. Input signals come from keys, buttons or perhaps other sorts of sensors. Now, since little is known about the internal programming of our black box, it is likely that its response will be pretty unpredictable. In effect, what comes out is governed primarily by chance operations. Controller chips can be scavenged from junk and adapted to something Cagean with minimal expense and effort, which adds to the idea's appeal. If a scrounged bit of gear isn't sonically appealing enough, or a modification error leads to an early demise (silicon chips won't work after you let the smoke out), tossing it aside is of little consequence.

"Xenia told me once that when she was a child in Alaska, she and her friends had a club and there was only one rule: No Silliness."

Quotes within boxes throughout this article are from from **Indeterminacy**, John Cage, 1958.

DAWN OF THE MECCANION

I got my first Meccano set (note to American readers: this is the British antecedent of Erector, and is demonstrably superior in scope) when i was a very small child, and had many years of fun with it. It languished in storage for ten years before i was inspired to retrieve it from my ancestral abode. Late in 1988 i had discovered a copy of Pierre Bastien's *Mechanium*, a slightly weird jazz album which had a few conventional instruments played by a machine constructed mostly out of Meccano. This quickly made me reason that Meccano had great utility in experimenting with building (anti)musical devices. Unlike Bastien, i have wanted to construct new sound sources rather than use the medium to activate conventional ones.

The first project developed with Meccano was the prototype of the hammer mechanism used in the Piandemonium. Not having a piano at my disposal, i used a large piece of scrap steel as the sound source. This machine no longer exists, having been dismantled in late 1989, and unfortunately no photographic documentation exists. I still have the piece of scrap steel, though, so i may at some time re-create this monotonic instrument.

> "Artists talk a lot about freedom. So, recalling the expression 'free as a bird,' Morton Feldman went to a park one day and spent some time watching our feathered friends. When he came back, he said, 'You know? They're not free: they're fighting over bits of food.'"

I was pretty much resigned to do very little creative work with Meccano, as the set that i had was not altogether large, and more used parts seemed impossible to find. New sets are still available, although at prices which are prohibitive for large-scale developments. By sheer fluke i discovered in early 1991 something called the "Canadian Meccanoman's [sic] Newsletter," which got me out of this rut. In addition to availing me to a large used parts market, it has also provided a great deal of ideas on how to stick these parts together to produce something fabulous. I must note that i'm cooking up things which are considerably more deviant than those built by most Meccano enthusiasts. Many of these fellows simply have no appreciation for the works of Rube Goldberg, let alone such contraptions which make an awful lot of noise (or a lot of awful noise, depending on how you look at things).

The first instrument constructed was a purely mechanical percussion machine (Figures 1 and 2). By "purely mechanical" i mean that no electronics are involved, although the entire works is driven by a small motor taken from a cassette player. This machine has evolved to the point where up to ten different sound sources are banged, plucked or shaken. Most of the ten elements have clutch mechanisms which allow the sounds to be selectively silenced. Construction was begun in February 1991 and was completed a year later, although I continue to make minor modifications to this day.

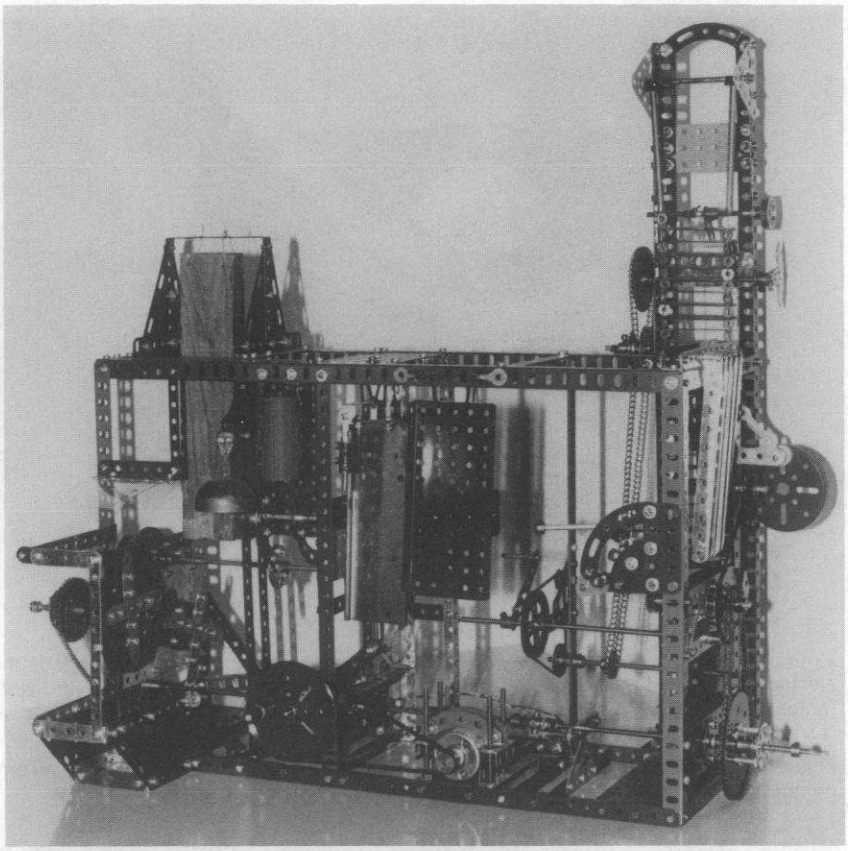
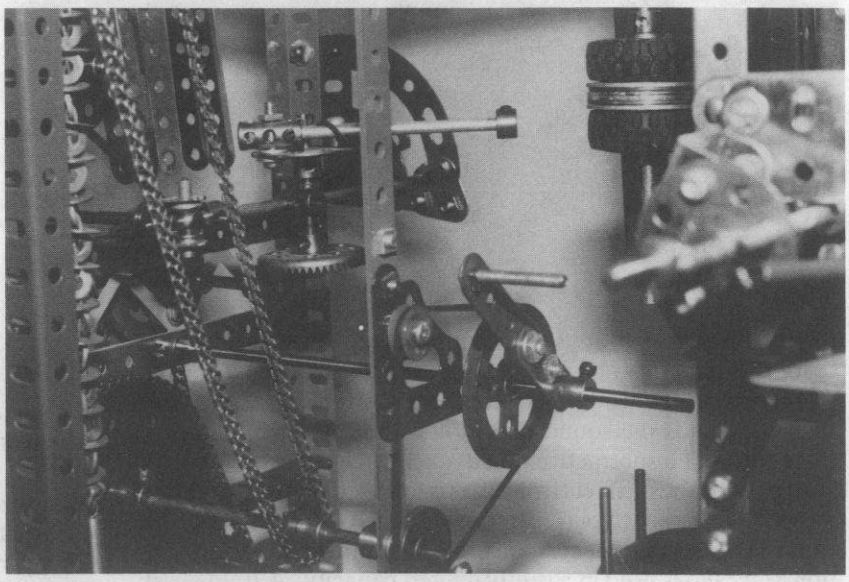


Figure 1 (above): Noise Factory [the "purely mechanical percussion machine" referred to in the text]. Overall front view.

Figure 2 (below): Noise Factory. Detail rear view showing some of the sound-making mechanisms, including "Strip Rattler" (horizontal axle with brass parts at both ends, at upper centre) and "Flanged Plate Thumper" (arm with pulley on long horizontal axle, at lower right).



THE DEATH OF VINYL, PARTS 1,2,3,4...

Numerous influences are at fault here. The first experiments, completed in mid-1990, were brought about by listening to too much Christian Marclay. He sometimes uses special diamond saws to slice records into pie-shaped segments, which he reassembles into collage records. I prefer the brute force approach: score the disc with a sharp knife and then snap along

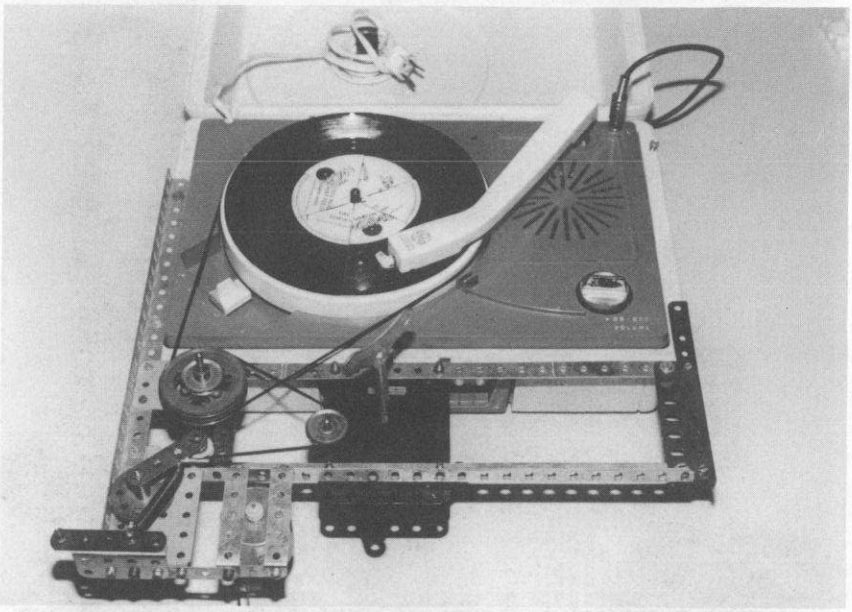


Figure 3: Turntable One. Overall view with clockwork motor engaged. To engage the electric motor, the drive belt can be shifted from the pulley near the key on the clockwork motor to the small white pulley on the electric motor below. The phonograph record shown is a six-slice composite.

Figure 4. Various composite and altered records for use on Turntable One. Not recommended for playback on high fidelity home entertainment systems.

the line. The results are somewhat unpredictable as the needle tends to bounce a little when it reaches the juncture between the two segments. However, because there's always a groove where the stylus lands the sound output is without interruption, so i think this isn't a subtractive quality.

To get the best effects from all this tortured plastic i modified a cheezy little record player to run with a DC motor (Figure 3). This was the second Meccanion project, although in this application Meccano is used in a pretty limited capacity. A framework of girders is attached to the case of a General Electric RM110A record player. This framework holds another one of those cassette player motors and a Meccano clockwork motor as well. Either of the motors may be used to spin the platter, the choice made by the simple means of moving a rubber drive band to the desired motor pulley. The electric motor allows me to play a record at any speed from about 5 rpm to about 175 rpm, either forward or reverse. The clockwork motor always runs out of energy before the record is finished thus resulting in an amusing winding-down effect. Playing 1920s Hawaiian records at 20 rpm backwards sounds incredibly sinister. Tepid middle-of-the-road jazz albums are improved considerably by 60 rpm playback. I have over 50 dics in my "junk records" pile, and thus can mortally offend the purists of any musical persuason. I started work on this instrument in March 1991 and it reached its present state in October of that year. I hope to add steam power to it sometime soon.

To steal a phrase from the Canadian Recording Industry Association, the next phase of the project was "Fifty times past what we would expect." December 1991 found me bent over a power saw, carefully slicing four LPs into pie-shaped portions, and then trimming off the portion with the label affixed to it. The records i victimized comprised a Neil Young album, Harold Melvin and the Blue Notes, the Gunther Kalmann Children's Choir singing Christmas carols, and lastly some unidentified schmaltzy group performing "The Jazz Soul of Porgy and Bess." The variety of material was quite deliberate.

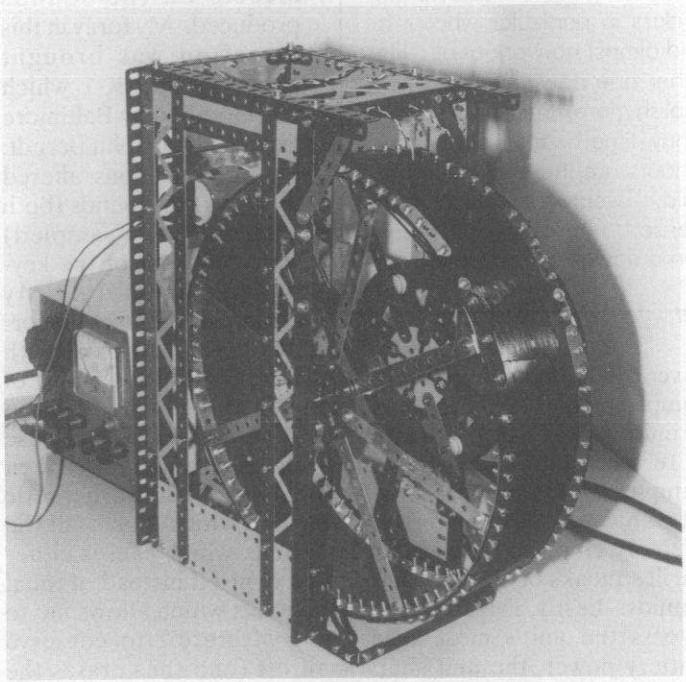
Instead of merely reassembling the vinyl pieces into composite discs, i performed the greatest indignity imaginable to the original recordings short of, i suppose, ceremonially burning them. I painstakingly affixed each pie-segment to the cylindrical surface of a drum of Meccano 14 cm wide and 32 cm in diameter, approximately the size of a big stack of LPs (Figure 5). Because the vinyl pie-segments are flexible, i was able to bend them to fit the curved surface without them shattering to bits. The drum is rotated by another of those DC motors extracted from tape players, at speeds ranging from under a revolution per minute to perhaps 100 rpm. The resultant groove resembles a slalom course and needless to say conventional LP playback hardware cannot cope with this sort of madness! To get around this i cemented a couple of straight pins to piezo squeakers (the noise emitting elements that are used in those insidious beeping digital watches) and used the stiffness of the lead wires to hold the pinpoints in the grooves. In this arrangement these improvised pickups have nonexistent bass response, which is ideal as then they don't reproduce much of the thud of the needle passing from one segment to the next.

Even with the pickup arrangement described, very little of the sonic information in the original recordings is reproduced. Much of the time the needles jump and skitter across the record surface, punctuating the weird screeches and groans with brief glimpses of tonal sound. The results are pretty much entirely amusical. At high speeds the highly rhythmic nature of the beast comes to the fore, lending the inspiration for its nickname: The Drum Machine. I started working on it in November 1991 and completed it three months later.

And lastly, i've been toying with explorations in the "if it doesn't have grooves then it isn't

"On Christmas Day, Mother said, 'I've listened to your record several times. After hearing all those stories about your childhood, I keep asking myself, 'Where was it that I failed?'' "

Figure 5:. The Drum Machine. The black outer surface of the drum are wedge-shaped pieces of phonograph records. The electrical device at left is a variable power supply, allowing variable-speed operation.



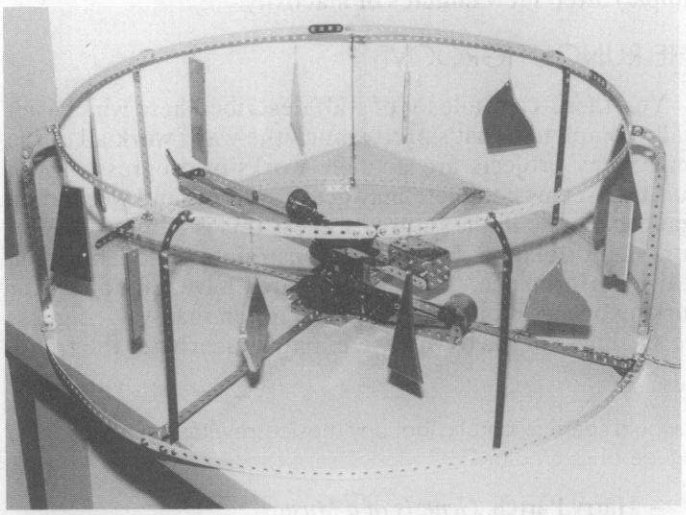
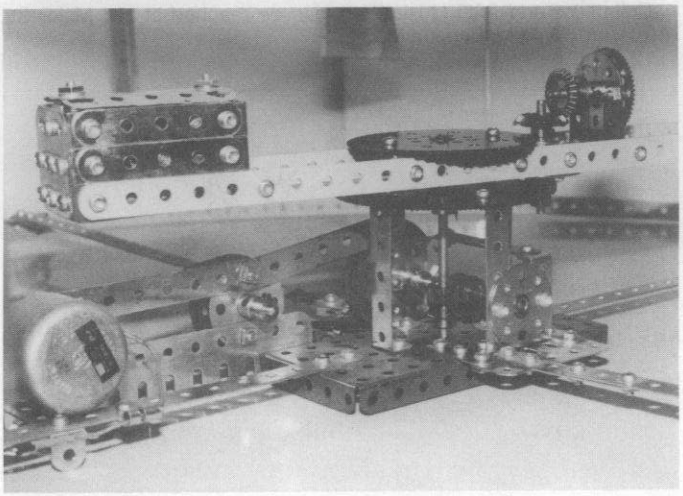


Figure 6 (above): The Rotary Club. Overall view from above.

Figure 7(below): The Rotary Club. Close-up of drive mechanism. The cassette player motor is visible at extreme left.



a record" department. Namely, it's a pretty straightforward procedure to take a compact disc and carve a spiral groove in it using a metal lathe. The troublesome part is actually obtaining cheap (preferably free) CDs to victimize in this fashion. Needless to say, the C.R.I.A. would definitely not be impressed by this sort of behaviour, so please don't tell them about it.

THE ROTARY CLUB

A motley collection of small scraps of sheet aluminum are suspended from a circular Meccano frame approximately 60 cm in diameter (Figures 6 and 7). An arm rotates at a few revolutions per minute in a horizontal plane beneath the scraps. A small "club" at the end of the arm spins around 21 times faster than the arm itself. It is this small club which strikes against the aluminum pieces. I wanted to have a faster-spinning striker to provide a louder, clearer tone. Interestingly enough, while the utility grade aluminum i used is pretty crummy stuff to machine, it has excellent acoustical properties.

This machine, the fourth in the Meccanion series, was constructed during a feverish week of activity in February 1992.

ELEKTROMECHANISCHE KUNST

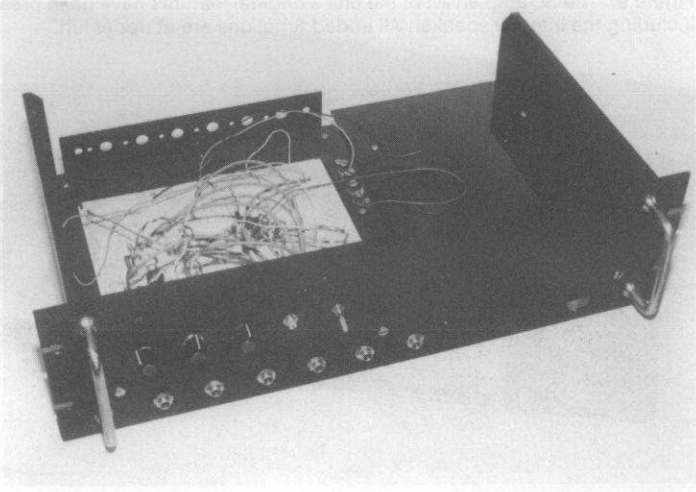
Preliminary work has been done on a few more Meccanion instruments but none have been completed. Three of them utilize sound-generating electronics while another one is an acoustic string instrument. Two of the electromechanical instruments use the magnetic properties inherent in a steel construction system. More about these will be revealed when work progresses and details become known. I anticipate eventually having a dozen or so machines comprising the Meccanion, provided i don't exceed all available space or budget.

> "In Zen they say: If something is boring after two minutes, try it for four. If still boring, try it for eight, sixteen, thirty-two, and so on. Eventually one discovers that it's not boring at all but very interesting."

AUDIOSTERISER

The concept for this unit (Figure 8) originated from musings about tape-edit and cut-up techniques, and from discussions with Cal Woodruff, back in late 1989 or early 1990. The unit has a number of inputs, which connect to external sound sources such

Figure 8: Audio Test Bed. The AudiOsteriser is starting to take shape in the mass of wires and parts on the white plugboard.



as radios or phonographs, and a single output. Inside is a control matrix that switches each input to the output in a timed sequence. Hooked up to several radios tuned to "talk" stations, this device could be used to generate instant radio art: as the output bounced from station to station its garbled nature would transform even the most annoying demagogues into entertaining listening. See, experimental music has importance to all members of society.

The time interval that each input is active is controlled by a front panel knob. Yes, it's true that i prefer old-fashioned buttons and knobs over the modern LCD displays with keypads. I need something i can physically grab hold of to make the best use of it. Originally i planned to have each input "hard switched" (which is to say, either completely passed through or entirely off). Since then, advances in available technology have made it easy to "fade" or "pan" the various inputs. Oboy, more panel knobs. Also, i've decided to add random switching sequence capabilities to the unit. And it also seems eminently practical to add a MIDI-in jack to allow the unit to be used as a conventional MIDI-controlled mixer. I'm not a very big fan of MIDI but sometimes it has its uses.

Later on (9 June 1991, via the Canadian Broadcasting Corporation) i discovered a radio-art technique developed by Dan Lander. He has run recordings of spoken word material through a noise gate with the threshold set much higher than normal. What this does is chop out the low-amplitude segments out of the recording. As the gate threshold is increased the speech becomes more and more garbled. This has motivated me to consider adding level-controlled switching of the input matrix, instead of or in addition to the aforementioned time-controlled switching. Gosh, even more panel controls. That panel's going to look like a 747 cockpit when i'm done.

I'm having a bit of trouble with the name for this creature. Without capitalizing the "O" the compound wording becomes unclear, and with the capitalization it sounds like an infernal device which munches on German bourgemobiles. (Not that that isn't a bad idea...)

THE SCRAMPLER

Readers may be familiar with the Casio SK-1, which is a very simple and small sampling keyboard. It's certainly more of a toy than a serious instrument, although this may easily be changed by a few simple modifications which have extreme effects on the sounds produced. My foray in this direction was brought about by an SK-1 which was modified by Baltimore experimenter John Berndt. His modifications altered the ways that sounds (both "canned" and sampled) were read out of the keyboard's memory. My scrampler (Figure 9) incorporates his work, with several additions. Firstly, i greatly increased the amount of sample memory. The control chip in the keyboard is too primitive to recognize the pesence of more memory, so i use it to store multiple samples. I can also bounce between samples while they are being played, sort of like a cybernetic fit of hiccups. I've also added a switch which makes all the memory chips be read at the same time, which causes either shrill squeaks or staticky thuds to be emitted instead of tonal sounds. Lastly, i've added a few controls which allows me to bypass the unit's most aggravating "feature": to conserve battery power, the unit shuts itself off (and thus erases the sample) after a few minutes of inactivity.

> "Schoenberg always complained that his American pupils didn't do enough work. There was one girl in the class in particular who, it is true, did almost no work at all. He asked her one day why she didn't accomplish more. She said, 'I don't have any time.' He said, 'How many hours are there in the day?' She said, 'Twenty-four.' He said, 'Nonsense: there are as many hours in a day as you put into it.'"

THE RUNOUT GROOVE

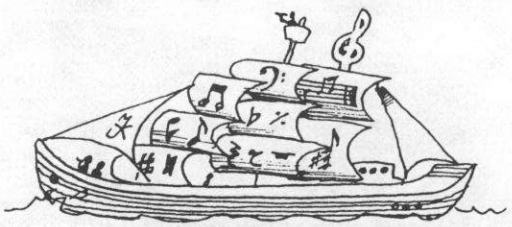
Yes, there's a whole lot of stuff described here which isn't really complete. That's pretty much the way i work all of the time: many projects are actually works-in-progress. Even stuff that seems complete may get dusted off and worked on again sometime in the future. I guess this is a by-product of working in isolation, free of the constraints of collaboration or live performance. I don't necessarily have a fondness for working by myself; it just seems to happen that way. I guess the smallness of the town i live in only exacerbates the trend.

"It would seem axiomatic that any music...reveals the philosophic attitude of its creator."

– Harry Partch, *Genesis of a Music*.

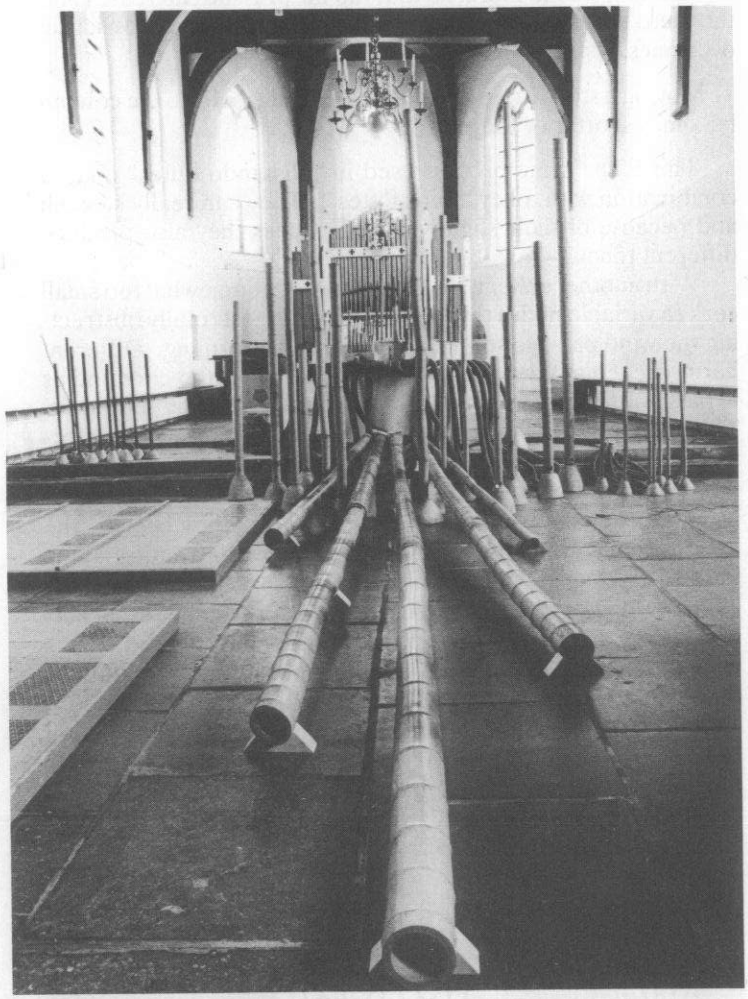
Figure 9: The Scrampler. All of the unit's original features have been preserved, including the internal speaker. All added functions are at upper left.

Colin Hinz and ASFi Music Work can be reached at 235 Major St., Toronto, Ontario, Canada M5S 2L5



A SHORT INTRODUCTION TO THE BAMBUSO SONORO

by Hans van Koolwijk
Translated from Dutch by John Lydon



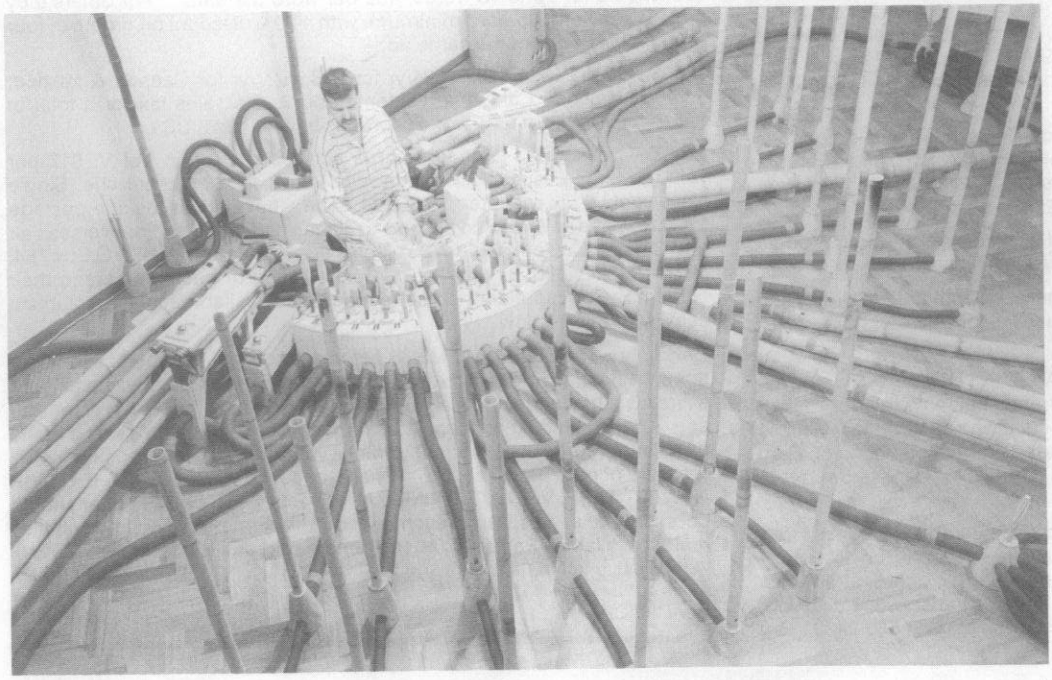
It is fascinating to see how sound is produced and can be altered, to hear how sound behaves in different spaces and to feel how it effects listeners.

Bambuso Sonoro was designed and built by myself, Hans van Koolwijk. It is still being developed, refined and enlarged. The instrument arose from a need to enable a single player to play more than one bamboo flute at a time. First five flutes, then ten, and today, in 1994, more than one hundred.

It is an unpolished instrument in which the visual element is intimately connected to the auditive. You must be able to see the sound, so to speak. You have to be there, preferably close by or between the flutes, see the player's exertions, experience the "difficulty-of-the-sound."

The main differences between this instrument and a pipe organ is that it works with variable wind pressure, thus maintaining many of the capabilities of mouth-blown flutes. For instance, it can play crescendos, glissandos and harmonics. It produces many chance subsidiary sounds, and each flute has its own character. This is in part because the bore of the pipes is irregular due to the knots in the bamboo.

The air is generated by a ventilator that feeds various dividing chambers – together forming the console – which distribute it among the flutes. The wind supply can be diminished to various degrees with slides on the console. This makes it possible for the player to effect a broad range of nuance in the tone of each individual flute: ranging from a single, thin tone to one with an incredibly broad harmonic spectrum. When all of the slides are open, the Bambuso Sonoro produces an enormous mass of sound: a stationary but nevertheless highly differentiated sound. The sound can be brought into motion using a system of valves with springs and membranes. The flutes produce rhythmic patterns, the speed of which is dependent upon the amount of air being supplied. The rhythmic patterns alter slowly and the keys influence each other at certain degrees of low air pressure, as



Photos this page:
BAMBUSO SONORO,
created by Hans van Koolwijk.
Photo credits: Above – M. van der Hoeven
Left – Reyn van Koolwijk

though the flutes were fighting each other. Two flutes may become mutually entangled in a quickly pulsing rhythm as though they were wrestling, an effect that lasts until they release their grip and each passes into its own rhythm.

There are a number of ways of altering pitches.

– Opening a slide more, so that the air pressure increases and the flute sounds a higher overtone. Some flutes are rich in overtones.

– Moving a stop in one of the flutes, closing it off, so the column becomes shorter or longer.

This is the same process used in "glissando flutes" and, in combination with a key, "bird flutes". They can really screech and because of their slightly varied pitches they also produce different tones.

With another system, the player passes a somewhat too small cork (a variable node) through the pipe, almost totally obstructing the wind passage so that the flute starts warbling. Different harmonics sound depending on the position of the cork and as it passes further, the sound jumps to the following harmonic. The many ways of playing this instrument also give the performance visual substance: image and sound reinforce each other.

The unruly and at times unpredictable nature of the Bambuso Sonoro is a product of its chance subsidiary sounds, the various sound qualities, divergent harmonics, glissandos, interference of tones, rhythmic patterns, and so forth. The conglomeration of these qualities makes this instrument especially well suited for the playing of unconventionally notated scores where the expression of a particular sphere is more important than the reproduction of exact pitches.

This instrument is the property of de IJsbreker Foundation in Amsterdam and it is supervised by me, Hans van Koolwijk. Further information is available on request to:

Hans van Koolwijk, Van Diemenstraat 412, 1013 CR Amsterdam, Holland.

NOTICES

HANDMADE STRINGED INSTRUMENT SHOW: Northern California Association of Luthiers (NCAL), formerly BASSIC, present their second annual exhibit and sale on Sunday October 9th, 1994 at Veteran's Memorial Hall, 6401 Stockton, El Cerrito, CA. For more information call (415) 206-9531. [10-1]

VOICE OF EYE / VESPERS. New CD includes handmade and indigenous instruments filtered through transparent electronics. Suggested for late night trance journeys on the ship of dreams. $12 ppd from Cyclotron Industries, PO Box 66291, Houston, TX 77266. [10-1]

THEREMINS are still manufactured by and available from Robert Moog's BIG BRIAR, Inc. Rt. 3 Box 115A, Leicester, NC 28748. [10-1]

NEW stacked lamination segment drum shells, custom built to order, any wood, reasonably priced. Retail/wholesale. Call for free brochure. (413) 532-3982. [10-1/10-3]

STROH VIOLIN, PHONO FIDDLE AND RELATED INSTRUMENTS: information, photos, etc., needed for an article currently being written for EMI. If you own such an instrument, know of a someone who does, or have access to documentation, and would like to share information, contact Cary Clements, 2417 Bryant St., San Francisco, CA 94110-3415, phone (415) 206-9531. [10-1]

HORSES SING NONE OF IT, a folk-based variety cable TV series from Morristown NJ, would be interested in having as guests on the show entertainers who make and/or play experimental musical instruments. Send promo to Ralph Litwin, 140 Morris Street, Morristown, NJ 07960; follow a week or two later with a phone call to Litwin at (201) 538-2432. [10-1]

1ères RENCONTRES HARMONIQUES (First Harmonic Encounters) – a festival at the Abbey of Thoronet at Var, France – takes place August 17 - 20, 1994. Innovative instrument makers to be featured include Makoto Yabuki, Jacques Dudon, Yves Rousquisto, Fred Stauffer, Serge Pesce and others. Several of the pieces will feature instruments made of natural elements (bamboo, clay, wood, stones, water). For information write Jacques Dudon's Atelier d'Explortion Harmonique, Les Camails 83.340 Le Thoronet, France, or phone (33) 94.73.87.78. [10-1]

The CompuServe Information Service will offer a month-long focus on making musical instruments this September and we invite anyone who is interested to join us. Exchange messages with instrument builders from around the world, participate in realtime conferences, download files from the library, and view images of musical instruments built by other participants. CompuServe is a telecommunications service (computer bulletin board system) that you access with your computer and modem. The September activities will be held in the Focus section (13) of the CRAFTS forum (GO CRAFTS) but be sure to drop into the woodworking section (11) to say hello and join the fun. For an introductory signup package with one month free basic services and a $15 usage credit, call 1-800-848-8199 and ask for rep. 304. [9-4]

AIR COLUMNS AND TONEHOLES: PRINCIPLES OF WIND INSTRUMENT DESIGN is a spiralbound booklet containing the four articles on practical wind instrument acoustics by Bart Hopkin that appeared in EMI in 1992 and 1993. The articles have been much revised and improved, and there are several additional features included. Published by Tai Hei Shakuhachi; available for $12.50 (no additional postage required) from Tai Hei Shakuhachi, PO Box 294C, Willits, CA 95490, or from EMI, Box 784, Nicasio, CA 94946. [9-4]

Complete or partial sets of proceedings (conference program, keynote addresses, paper presentations, transcripts of panel sessions) from last summer's Tuning of the World Conference at Banff are available from Office of the Registrar, Banff Centre for the Arts, Box 1020, Banff, Alberta, Canada, T0L 0C0, phone (403) 762-6180. Call or write for information.[9-4]

The Samchillian Tip Tip Tip Cheeepeeee is a musical instrument, a microprocessor-based MIDI controller designed by Leon Gruenbaum. A simple but powerful algorithm converts keystroke sequences from a standard computer keyboard into musical tones on an external synthesizer; the result is music never heard before with astonishing new harmonic contours. For information contact Leon Gruenbaum, 96 St Marks Place, NY NY 10009 Suite #2, phone (212) 475-5363 ext. 4. [9-4]

ANYONE CAN WHISTLE, known for its mail order catalog of unusual and beautiful instruments and sound toys, has opened a store in Kingston, New York, open 11 7 daily. Call (914) 331-7728 for information or to request a catalog.[9-3]

BIOFEEDBACK SOFTWARE/HARDWARE: WaveAccess has released WaveRider, a MS Windowsbased program with peripheral hardware that allows MIDIcompatable monitoring of biowaves. For information contact WaveAccess, PO Box 4667, Berkeley, CA 94704, (510)526-5881.[9-3]

A REMINDER Unclassified ads here in EMI's notices column are free to subscribers for up to 40 words; 40¢ per word thereafter. For others they are 40¢ per word, 15 word minimum, with a 20% discount on orders of four or more insertions of the same ad.

SUBSCRIPTIONS TO EMI: $24/yr for U.S.; $27/yr for Canada & Mexico; $34/yr overseas. California residents add 7.25% sales tax for a total of $25.74. Order from EMI, Box 784, Nicasio, CA 94946, USA.

EMI BACK ISSUES: Bound volume sets Vol I through Vol V: $17 per volume. Single issues Vol VI #1 through Vol VII #6: $3.50 per issue. Single issues Vol VII #1 and later: $6.00 per issue. These prices include postage for U.S., Canada & Mexico air, and overseas surface rate. For overseas air add 20%. In California add 7.25% sales tax. Order from EMI, PO Box 784, Nicasio, CA 94946, or write for complete listing of back issues and their contents. Corresponding cassette tapes also available for later volumes; see information below.

CASSETTE TAPES FROM EMI: $8 per cassette for subscribers; $10.50 for nonsubscribers. Prices include postage for U.S., Canada, Mexico air, and overseas surface rate. In California add 7.25% sales tax. For overseas air add 20%. Each tape contains music of instruments that appeared in the newsletter during the corresponding volume year, comprising a full measure of odd, provocative, funny and beautiful music. AND, HEY, OUR NEWEST TAPE, VOLUME IX, WILL APPEAR IN SEPTEMBER (that should be shortly after this issue reaches you). Volumes VI, VII, and VIII also remain available. Earlier volumes are now sold out. Order from EMI, Box 784, Nicasio, CA 94946.

"Koukin from Eastern Relics of the Hikawa Shrine, Omiya City, Saitama Prefecture" (in Japanese, with English abstract) by Yoichi Yamagata & Masato Watanabe, in **Koukin Journal** #6, June 1993 (1-12-24, Midorigaoka, Ageo, Saitama 362, Japan).

An account, with photographs, of the excavation of two iron jaw harps estimated to be locally made 1000 years ago. This is just one of several jaw harp articles appearing in this issue of **Koukin**.

"Measuring Instrument Pitch with a Pocket Tuner" by John Downing, in **FoMRHI Quarterly** #75, April 1994 (c/o Faculty of Music, St. Aldate's, Oxford OX1 1DB, U.K.).

Practical tips on the selection of and use of affordable electronic tuners.

"Making a Stamp or Branding Iron for Marking Musical Instruments" by G.E. King, also in **FoMRHI Quarterly** #75 (address above).

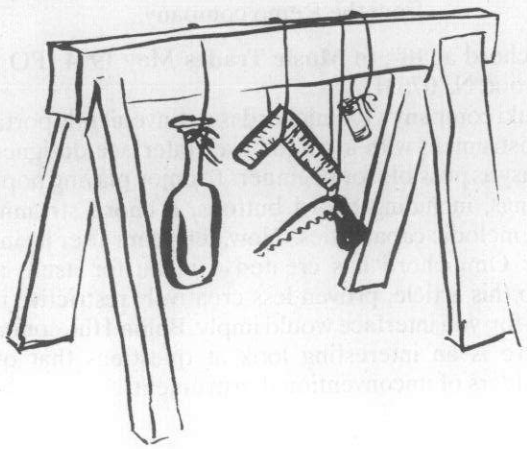
Suggestions for permanently marking musical instruments with a maker's seal. The approach suggested is reasonably easy and affordable.

CAS Journal Vol. 2 #5 (Series II) May 1994 (112 Essex Ave., Montclair, NJ 07042) has articles on guitar acoustics, violin plate tuning, effects of aging on violin tone, and certain aspects of violin construction technique and diagnostics.

The Galpin Society Journal XLVII, March 1994 (7 Perceval Ave., London N6 5HQ, U.K.) contains articles on 18th century harpsichords, the Japanese conch trumpet *hora*, a sixteenth century Polish folk fiddle, and several other topics, including an informative and accessible essay on the development of woodwind instruments from an acoustical point of view, originally written in 1985 by the late Arthur H. Benade.

American Lutherie #37, Spring 1994 (8222 South Park Ave, Tacoma WA 98408) contains an interview with John Koster (conservator of the Shrine to Music Museum), plus articles on building archtop guitars, historical lute making, violin set-up, and more.

Woodwind Quarterly #5, May 1994 (1513 Old CC Rd., Colville WA 99114) contains an interview with the flute maker Rod Cameron, an article on the interesting and idiosyncratic Irish bagpipe form known as Uilleann pipes, plus shop tips, book reviews and more.



The following is a listing of selected articles relating to musical instruments which have appeared recently in other publications.

"A Comprehensive Supplier List" compiled by Bill Mathews, in **TechniCom** Vol 19 #2, March-April 1994 (PO Box 51, Normal, IL 61761).

A list, with addresses and phone numbers, of manufacturers and retailers selling products of interest to band instrument repair technicians.

"Jean Weinfeld's Bauhaus Refrain" by Michael Peppiatt, in **Architectural Digest**, May 1993.

A report on the string instruments of the late European maker Jean Weinfeld. Weinfeld's instruments are extremely striking from a visual design point of view – just beautiful, really – though less impressive acoustically. Lots of pictures included.

"Sounds Like Fun: Acoustics on Display at Discovery Museum" (no author credited) in **Echoes"** Volume 4 #1, Spring 1994 (Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797).

Descriptions of several sound exhibits for children at the Discovery Museum in Acton, Massachusetts, with a photo of a large percussion aerophone (end-struck pipes) called the Slap-a-phone.

"Unusual Gourd Musical Instruments" by Christopher Tree, in **The Gourd** Volume 24 #2, Spring 1994 (PO Box 274, Mt. Gilead, OH 43338-0274).

A short discussion, with photos, of three gourd instruments: a shekere-like beaded rattle, water drums (inverted half-gourds floating in water), and the gourd equivalent of a pot drum (large gourd with a hole in the top, played by hand percussion).

"An Island Thrives on Water, Stone and Skill" by Sophia Dembling, in **The Seattle Times** Travel section, June 5th, 1994.

A report on three Japanese artisans in different crafts. One of them is Keiko Miyawaki, who makes lithophones (sonorous stone instruments). They are not modelled on traditional instruments, but follow designs developed by Miyawaki's father. Photo included.

"Bringing Back Barstow" by John Schneider, in **Guitar Review** Fall 1993.

The author describes his "quest to rescue a unique American work from obscurity" – that is, his pursuit of oral information, written texts, music scores and sound recordings in order to recreate an early version of Harry Partch's important work "Barstow" for voice and adapted guitar. The results of this effort can be heard on Schneider's CD **Just West Coast** (reviewed in EMI's June 1994 issue).

"Bells of Bronze Age China" in **Archaeology** Vol. 47 #1, January/February 1994.

A ten-page article on early Chinese bells, supplemented by three one-page articles: "Music in the Life of Marquis Yi's Court" and "The Sound of Bronze Age Music", both by Lothar von Falkenhausen, and "The Power of Bronze", by Kenneth J. DeWoskin.

"In Memoriam: Leon Sergeyevich Theremin (1896-1993)" by Bulat Galeyev, in **Leonardo** Volume 27 #2, 1994 (MIT Press Journals, 55 Hayward St., Cambridge, MA 02142-9902).

Galeyev's *in memoriam* for Theremin is not a catalog of achievements, but an insightful (though cursory) look at his life in Russia in a time of political repression.

"Electronic Redemption" by Mike Ewanus, in **Contact** 7.3, March 1994 (4001 Berri #202 Montreal, QC, Canada H2L 4H2).

Thoughts on the artistic use of radio noise (hiss, hum, feedback, static), and concerns about the disappearance of such noise through digital cleanliness, concluding with a call for greater freedom of access to radio as a medium.

"An Alternative to the Organ for the Practice and Performance of Organ Literature: The Modern Pedal Harpsichord" by David R. MacDonald, in **Continuo** June 1994 (PO Box 327, Hammondsport, NY 14840).

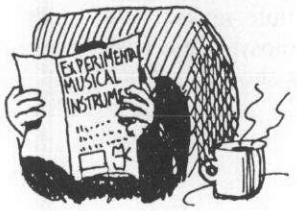
Notes on the construction and use of a harpsichord with an organ-like pedal board. While historical precedents exist, the instrument described is a modern adaptation.

"Think-a-thon: Odyssey of the Mind stresses students' creativity" in **The Des Moines Register**, May 31, 1994.

A report on a creative thinking program and competition in which young people are challenged to solve a technical problem. This year's challenge (if I read the ambiguously-worded article correctly) was the creation of three devices that, when combined, will play a tune. Unfortunately the article scarcely mentions the solutions the children arrived at.

"A Portable Glass Organ and a Glass Harmonica," excerpted from **E. Power Biggs: A Concert Organist** by Barbara Owen, in **Glass Music World** Vol. 8 # 1, Jan 1994 (2503 Logan Dr., Loveland CO 80538).

Part three of an excerpt describing the making of a glass armonica at the Corning glassworks for the well-known organist.



"Synthetic Mondo Heads for Congas, Bongos," in **Music Trades** April 1994 (PO Box 432, Englewood NJ 07631).

Brief promotional description of newly developed drum heads using "Legacy™, Mylar™ and Acousticon™ technologies," from the Remo company.

"The Omnichord at 10", in **Music Trades** May 1994 (PO Box 432, Englewood NJ 07631).

The Suzuki company's Omnichord is a conveniently portable electronic instrument with a unique user interface designed to make it as easy as possible for beginners to enjoy playing popular and folk songs, including chord buttons, a chord strumming feature, and melodic capabilities. Now, ten years after its introduction, the Omnichord has created a niche for itself, and, according to this article, proven less creatively restrictive than the do-it-all-for-you interface would imply. Behind the commercial fluff here is an interesting look at questions that often confront builders of unconventional instruments.

(Continued on page 43)